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ABSTRACT

Following an introductory paper on Pittsburgh and the arts, 57 conference papers are presented under the following four major categories: (1) "Imagery, Science and the Arts," including discovery in art and science, technology and art, visual design of newspapers, multimedia science education, science learning and interactive videodisc technology, hypermedia, and visualization in science and the arts (8 papers); (2) "Research and Theory," including rehearsal strategies, commercial literacy, visual design in the planetarium, picturing text, instructional materials evaluation, drawings and videotapes in riding instruction, international icon symbols, information tracking, color codes and verbal material recall, teleconferenced instruction, prototypic visual images in high school mathematics, redundancy in television messages, environmental linguistics, icon images in HyperCard, visual acuity of radiologists, information literacy, visual verbal relationships, and imagery in motion media (22 papers); (3) "Computers and Visual Literacy," including e-mail, expert systems, image databases, interdisciplinary study and multimedia, intelligent advisor systems, workplace literacy software, visual simulations, and virtual reality (11 papers); (4) "Teaching and Learning," including linking art and chemistry, visualizing the complexities of instruction, architectural images, holography, synetics and imagery, nonverbal language, engineering presentation, and instructional television in diverse cultural settings (11 papers); (5) "The Visual Arts," including the new auteur movement, art and environment, and cognitive factors and visual images (5 papers). An author index is included. Most of the papers contain references. (MES)

Art, Science & Visual Literacy

Selected Readings

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Art,
Science
&
Visual Literacy

Selected Readings from the
24th Annual Conference of the
International Visual Literacy Association

Imagery in Science and the Arts • 1992 • Pittsburgh • International Visual Literacy Association

Edited by

Roberts A. Braden
Judy Clark Baca
Darrell G. Beauchamp

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Acknowledgements

This book of readings is a collaborative venture, and the editors would like to acknowledge the assistance of many individuals in the preparation of the book. In particular we would like to express our thanks to the people who participated in the proposal screening process: **Barbara Fredette, Diane Bercherer, Louis Berry, David Crossman, Ann Lyness, and Jack Simich.** Since the papers in this volume are all edited versions of presentations at the Pittsburg IVLA conference, an enormous debt is owed to **Barbara Seels** who was the initial conduit between the authors and the editors.

Because we wanted every paper to be read and edited by four people, it was necessary for the three editors to seek editorial assistance. The editors each read all of the papers, then we divided the stack of fourth copies into four piles and asked for help. We got fabulous input from four individuals who we would like to designate as...

ASSOCIATE EDITORS:
Dick Ball
Beverly Braden
Bob Griffin
Dennie Pett

Of course any big project puts a strain on family and friends. We hope that those near and dear to us know we appreciate their forbearance and their support. Big projects also have a way of drawing aid from our coworkers around the office, and special thanks go to **Joanne Colbert, Chloe May,** and **Rick Hannemann** who solved some of our correspondence and production problems.

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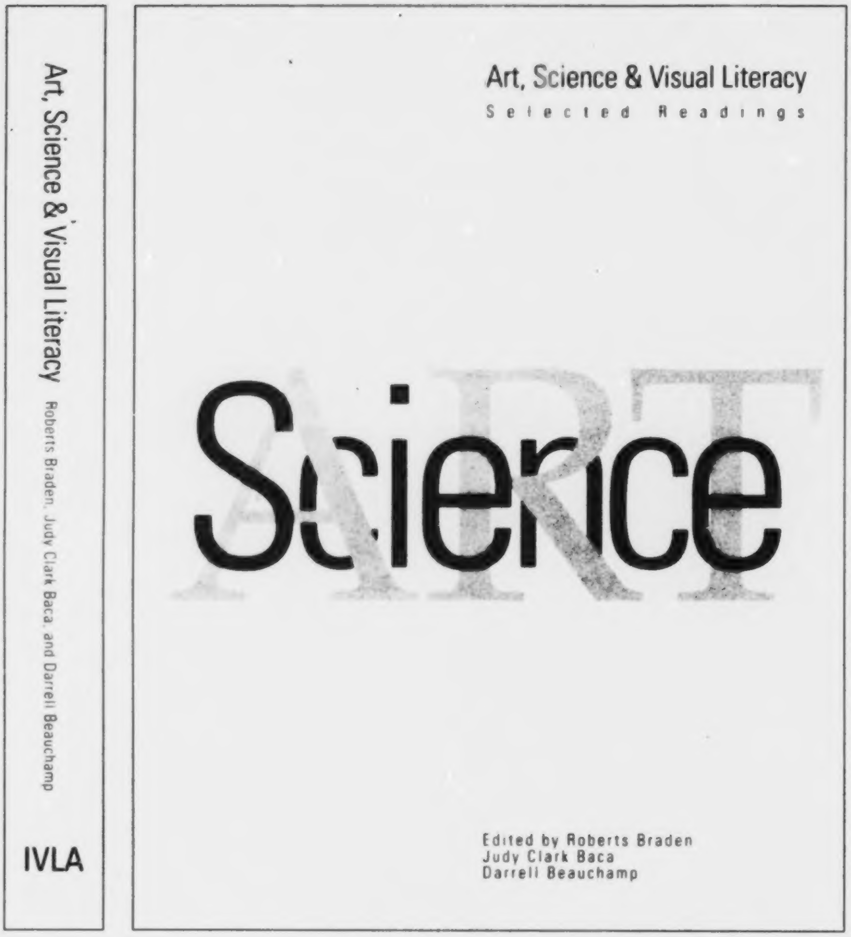

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IVLA

Art, Science & Visual Literacy

Selected Readings

Science

ART

Edited by Roberts Braden
Judy Clark Baca
Darrell Beauchamp

About the Cover.......Kevin Cahill was commissioned to design the cover for this year's book of readings. The logo from the Pittsburgh conference which appears several places in this volume was available, but unfortunately was dated, and the editors try to avoid putting dates on the cover. So Kevin started his commission with only four pieces of information: (1) *Visual Literacy*, the thing that all of the contents of the book have in common; (2) the conference theme "Imagery in Science and the Arts;" (3) the fact that the book contains "Selected Readings;" and (4) the names of the editors. Kevin's original design was for two colors of ink, yellow and blue, which when mixed gave a third color, green. The yellow and blue were used for the letters in Science and when blended together the green came out as ART. The strong solid S_e_e is intended as a key word representing VISUAL literacy. In the monochrome version used on our cover, Kevin has cleverly re-worked his design so that if you look closely you can **See** the **ART**in **Science**. Kevin Cahill teaches graphic design at California State University, Chico.

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Pittsburgh and the Arts
or
How My Eye Was Formed

by
Susanne A. Roschwalb

I learned visual literacy as a child of Pittsburgh in the second half of the 20th century. The steel city was a remarkable influence in my aesthetic sensibilities. I carry with me the image of the red-hot, molten slag running down the hillside at night, of the black dust belched by the smokestacks by day. Along with the imagery of the steel mills, as a resident of the industrial city I was given some artistic opportunities that helped shape the foundation for my life in art.

William Blake once wrote "As the eye is formed...such are its powers." The story I am about to tell concerns the influence of Pittsburgh's cultural institutions on me in my first decade of life, how my eye was formed by the steel city, and the impact on the rest of my life.

No American city was so intensively industrialized as Pittsburgh. It was Pittsburgh that gave airplane pilots the light of a hundred blast furnaces which glowed all night as their main navigational guide. It was Pittsburgh that gave the world modern food processing, AC electricity, the first mass-produced oil, steel, aluminum and glass.

But, it was the artistic life that the city gave to me. "Give me your child before the age of ten," said Pittsburgh's art institutions, "and she will be with us for the rest of her life."

And it was true. I grew knowing the names of certain artists who did their best work in Pittsburgh. I heard the music of Stephen Foster, saw paintings by Mary Cassatt, was reading stories by Willa Cather, went to Gene Kelly's dancing school, and later studied under a disciple of Martha Graham's. I was told about George S. Kaufman, Rachel Carson, and as a teenager, worked with Fred Rogers.

The region was unusually rich in musicians, painters, photographers, filmmakers and writers. Not only Stephen Foster, but Errol Garner, Art Blakey, Billy Eckstein, Byron Janis, and Lorin Mazel made music in Pittsburgh. American

10

scholarship has not studied this remarkable city for its contribution to the arts. A staggering productivity has come out of Pittsburgh including Andrew Carnegie's several thousand public libraries around the world, George Ferris' carnival wheels, Stephen Foster's songs. Seven of Pittsburgh's fabled collections of art have left the city. I have worked and/or enjoyed three of them in Washington, D.C. -- Andrew Mellon's canvases and Paul Mellon's modern paintings at the National Gallery, and Duncan Phillips exquisite Post-Impressionist art at the Phillips Gallery.

Now, three decades after I left Pittsburgh, I can remember each artistic fount and cultural reservoir that served me so well. I have enjoyed the privilege of revisiting these institutions to discuss them with you with a child's love and an adult's eye.

Carnegie Library and Carnegie Museum

Andrew Carnegie, born in a weaver's cottage in Dunfermline, Scotland in 1835, came to the United States in the mid-19th century. When Carnegie was a boy in Allegheny city, a Colonel Anderson had opened his personal library of 400 volumes to the mechanics and workmen of the town. Every Saturday, Andrew went to the Colonel's house to exchange books. "No one but he who has felt it can know the intense longing for the arrival of Saturday and a new book," he said.

Hard work and shrewd investments in bridge-building, railroad sleeping cars, oil wells and the steel mills of Pittsburgh had made Carnegie wealthy. He gave away most of his money and the principal object of his philanthropy was the public libraries he created in the English-speaking world.

In 1910 Carnegie gave $6.4 million to Pittsburgh for a library, concert hall and museum. The importance of the Carnegie Institute for Pittsburgh goes beyond its size. Architecturally, the eight-acre building is the grandest monument to Beaux-Arts planning in the city. The competition for the design of the library was the most heralded contest in American architecture up to that time and drew entries from 96 architects in 28 cities. Culturally, it marked the end of the Dark Ages for a town that had wealth but little real culture before the Institute opened. (Willa Cather wrote a short story, "Paul's Case," which is partially set in the library and music hall.)

Altogether, Carnegie donated $56 million for 2,509 library buildings and, by the end of his life had given away more than $333 million for philanthropies.

I visited Carnegie Library every week from the time of my first library card at age seven. I was taken to chamber music concerts in the Music Hall and learned the great piano concerti from records I listened to in the non-print section. I saw my first art exhibits in the art gallery. Years later, I worked on two

White House Conferences for Library and Information services, my way of saying thank you to Andrew Carnegie.

Nationality Rooms-University of Pittsburgh

In 1920, John Bowman was appointed chancellor of the University of Pittsburgh. He decided to create the most extravagant college building in the world. Bowman needed a building that would be a towering beacon to raise the importance of Pitt over an industrial landscape that had little use for education. (Pitt is now the city's largest employer.)

Originally, it was to be the second tallest skyscraper in the world. Bowman got the site from the Mellons. The designer was Charles Klauder, a Philadelphian. Construction began in 1926, continued to 1929, and was not completed until 1937. The tower is a 40 story elevation. Functionally, it never worked well, but for Bowman, the objective was to create a physically and psychologically dominating architectural piece. In that he succeeded. For a million working class parents in Western Pennsylvania, higher education means getting their children into what became known as the "Cathedral of Learning" at Pitt.

A remarkable part of the University is the Nationality Rooms, conceived in the 1920's by sociologist Ruth Crawford Mitchell as a means of linking the University with the immigrant cultures of steelworking families. Each room is a reproduction of a specific environment from fifth-century B.C. Athens through eighth century A.D. China.

While all of the rooms are interesting, I appreciated some over others. I have traveled around the world and worked on arts promotion projects on behalf of seven or eight countries, all of which I first glimpsed through the Nationality Rooms. What a way to learn cultural diversity.

As the first generation child of parents from Czechoslovakia, I was fascinated by the Czech room. The room evokes memories of a Slovak farmhouse and one of the world's oldest universities. The words "Pravda Vitezi" (truth will prevail) proclaim the motto of the Czech Republic.

Prague artists Karel and Marie Svolinsky painted the beamed ceiling with botanically accurate flowers and plants familiar to every Czech. Their "tree of life" design surrounds the text of the Proclamation by Charles IV, King of Bohemia and Emperor of the Holy Roman Empire, which marked the founding of the University of Prague in 1348. Murals depicting miraculous trees bearing flowers and fruits, and harboring animals, birds and insects decorate the plaster reveals of the bay window area.

Ceiling panels portray eight famous persons in Czech and Slovak history. A portrait of Thomas Masaryk, President-Liberator of Czechoslovakia

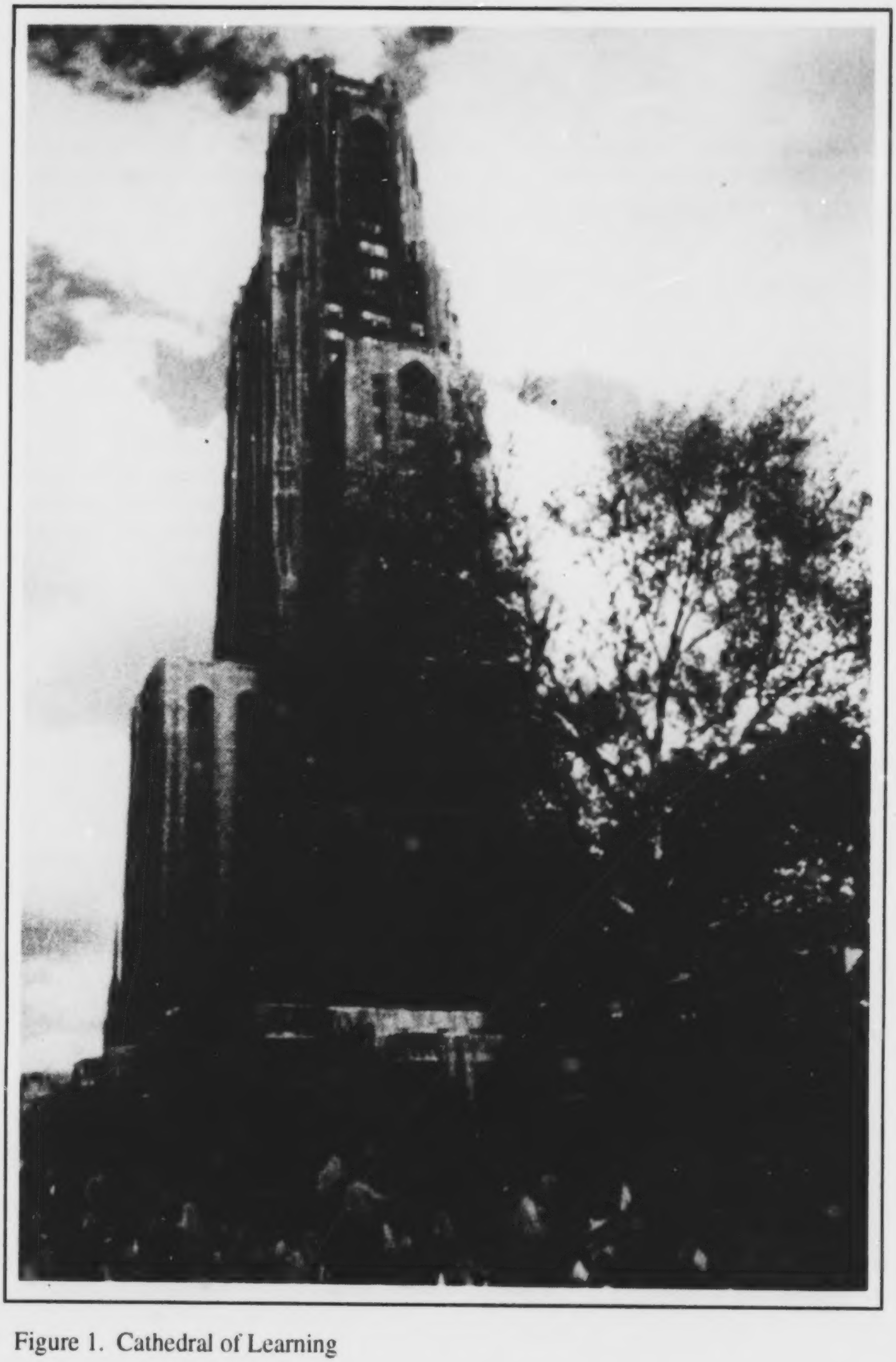

Figure 1. Cathedral of Learning

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dominates the front wall. Fine embroidered lace, Bohemian crystal and other treasures are displayed with the room's archives in the wall cabinet.

Twenty years after I left Pittsburgh, and forty years after my mother left Prague, we took a trip to reclaim our roots. The city of Kafka, Mozart and the great filmmakers of the 1920's was a place I was prepared to adore.

Other rooms that planted seeds of interest to countries I later visited: English, Scottish, German and Italian Rooms. But the Greek and Russian rooms foreshadowed adventures. The Greek Room with gleaming white Ionic columns, pilasters and doorway quarried from Mount Pentele, the same mountain that yielded the marble used to build the Parthenon, and student chairbacks with the names of Greek Islands and towns, was an inspiration. Greece was among the first foreign countries I visited. And, when I worked on the promotion of the exhibition "The Search for Alexander," and took a group of American art critics to Macedonia to visit the tombs and objects *in situ*, I was so much at home I even believed I was Greek in another life.

The most exciting was the Russian Room, glorious in religious symbols, animal motifs and floral patterns. The vishivka, contains 16th & 17th century brocade, petit point, appliqued and embroidered damask and velvet,which depicts Moscow's patron saint, St. George, slaying the dragon. A replica of a family icon hangs above a corner cupboard. The room, with its Byzantine and folk motifs, seemed wonderful to me as an elementary school visitor. A year and a half ago, when I visited Moscow as part of a delegation of mass communication professors, the wonder continued. It was, in fact, the most exciting trip of my life.

THE YOUNG MEN AND WOMEN'S HEBREW ASSOCIATION (NOW KNOWN AS 315 S. BELLEFIELD)

The Y was a product of Edgar Kaufmann - the same Kaufmann who, in 1913, purchased the first of 1,500 acres for a country retreat that is now world-famous as "Fallingwater." The retreat was designed by Frank Lloyd Wright and built in 1937. Overall, Kaufmann was Wright's outstanding patron. Their partnership lasted twenty years and yielded nearly a dozen uncompleted projects in addition to two that were realized.

The Y, however, was designed by Benno Janssen in 1924. The building married one facade from the Italian Renaissance and another from eighteenth century Virginia. That improbable combination worked in form and function. I entered the Y regularly to study dance, to teach art to young children and to perform in musicals.

SYRIA MOSQUE

Pittsburgh society has always been gregarious. Church clubs, singing clubs, sports and general

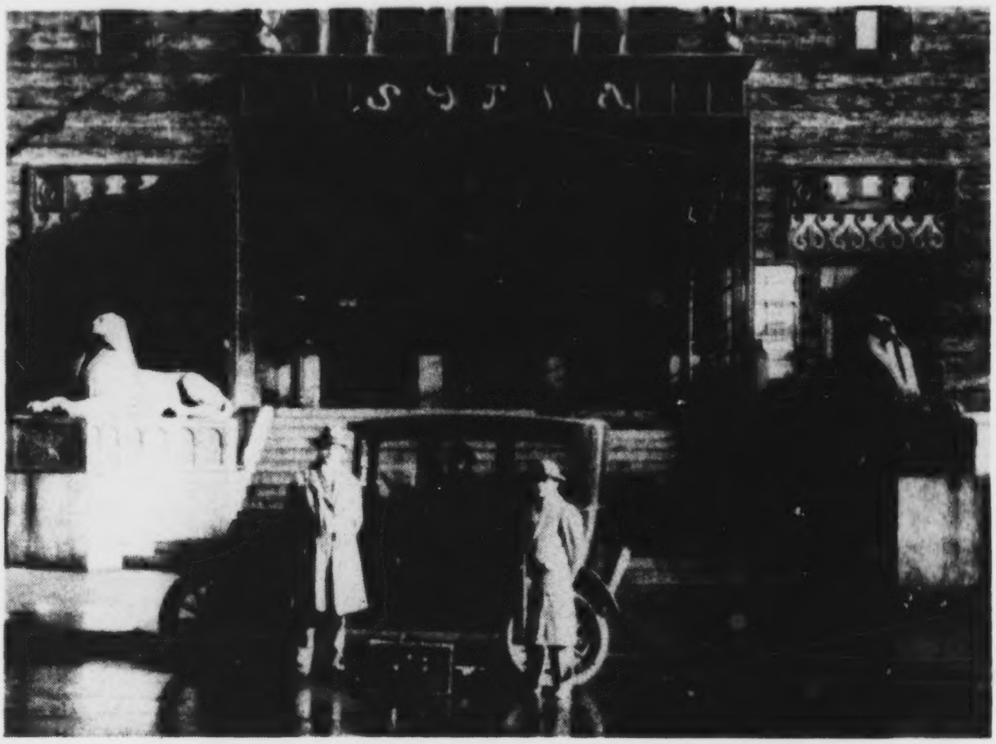

Figure 2. Syria Mosque

purpose social clubs number in the hundreds. Approximately two dozen clubs are regarded as exclusive with a concentration of these in Oakland. The Syria Mosque was on Bigelow Boulevard from 1915 until its misguided demolition a few years ago. It had many peculiarities, from its Arabic inscription to its complicity in the death of Eleanora Duse, who died after she was caught in a downpour outside its locked stage door. The building represented a Hollywood view of Islamic culture; silky bronze sphinxes, stalactites on the cornice and a Hagia Sofia saucer dome poking through the roof.

But the building functioned wonderfully well as a theater and concert hall for 3700 spectators. The Pittsburgh Symphony played here for years under Fritz Reiner. There I saw the productions of the Ballet Russe de Monte Carlo. From ballet, I learned to see beauty in discipline and perfect motion. After each performance, my mother took me to the elegant Webster Hall, then a hotel and now an apartment house, for petits fours and hot chocolate.

MARY SCHENLEY AND HER PARK

The Oakland section would have become another worker neighborhood in Pittsburgh had it not been for a woman

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who clung to its past. The woman was Mary Schenley. Mary Elizabeth Croghan Schenley was barely out of her teens when she inherited one thousand acres of choice land in central Pittsburgh from the holdings of her grandfather.

She chose not to live in Pittsburgh. At fifteen, she eloped with a captain in the British army who was twice-widowed and three times her age. But she retained her loyalty and, in 1893 she donated 400 acres to create Schenley Park as the eastern border of Oakland. When she died in 1903, she had not set foot in Pittsburgh for forty years.

The decisive move in the creation of Beaux Arts' Oakland was made in the next year, 1904, when when Andrew Carnegie weaned away twenty acres of Schenley Park had already received Phipps conservatory in 1893, an artificial ice rink, a band shell, a racetrack, and electrically operated water organ, and extensive boating facilities on the artificially created Panther Hollow Lake.

Edward Manning Bigelow, the head of city planning, directed the design of four bridges to give the city access to the new park. Two of these are now replaced, but the Panther Hollow Bridge arches over its gully as Bigelow intended, complete with four splendid bronze panthers. Panthers, actually mountain lions, mascot for Pitt, were hunted here until the early 19th century.

The wonderful band shell was the impetus for outdoor band concerts. These summer evening symphonic events were free and open to the public. They were the first place where I remember listening to music and watching the stars. Years later, when I helped plan some of the 82 free inaugural concerts for President Jimmy Carter, I remembered the spirit of community engendered by free, open-air concerts.

Also in Oakland, when I was young and impressionable, was the Pittsburgh Playhouse, where I first attended children's theater and later adult plays. That is where I learned that there is such a thing as the human condition and theater gives life to life. Years Later, when I became the publicist for Washington's famed resident, repertory company, Arena Stage, I remembered the smell and the sound of backstage and rehearsal theater from my youth.

SQUIRREL HILL--MY HOME

Brendon Gill, theater critic for the New Yorker, has said "If Pittsburgh were located in Europe, people would travel a thousand miles to visit it." I knew that as I grew up. I lived in the Squirrel Hill section. One of the prominent portals to Squirrel Hill is Shady Avenue. The corner is anchored in the neo-Georgian mansion occupied by the Pittsburgh Center for the Arts, Pennsylvania's largest art center, with classes, recitals, lectures, conferences, exhibits, happenings, and outdoor concerts.

I received a dance scholarship to the Center and studied modern dance under Rose McCurgie, a student of Martha Graham's. I danced to the music of Duke Ellington. I learned folk music and jazz. I also learned flower arranging at the center. Years later, when I represented the American Horticultural Therapy Association, I remembered the healing powers of working with miniature flower arrangements.

Squirrel Hill, by the way, became fashionable and populous, comparable to other major urban centers because of the advent of the electric trolley along Forbes and Murray Avenues in 1893, and the rebuilding of Beechwood Boulevard by Frederick Law Olmsted, Jr. in 1903. Olmsted, of course, is the landscape designer of Central Park, major parks in Washington, D.C., the Vanderbilt estates, etc. I never knew that he had a hand in the great boulevard near where I lived.

The boulevard, in turn, brought the building of magnificent mansions, including the Mellon mansion with its 65 rooms, organ, sumptuous, Tiffany windows, lavish marble, and magnificent formal gardens. No getting away from it, the Mellon family, with its fortune in banking, copper, and steel, was the backbone of Pittsburgh. My final tribute is to their sense of philanthropy.

PITTSBURGH RENNAISSANCE

By 1940, after a century of industrialization, Pittsburgh labored beneath a sky heavy with soot. Housing was inadequate, traffic unbearable, and industrial sewage was being dumped into the city's rivers. Not surprisingly, property values in the central business district began to drop at a rate of ten million dollars per year. As is told in the exhibit "Pittsburgh Defines a City," the National Building Museum exhibition now at Allegheny Airport, the growing crisis was met by a coalition of men who previously had opposed one another.

Within fifteen years, Richard King Mellon, Mayor David Lawrence, and others accomplished the truly extraordinary: Pittsburgh's skies and rivers were clearer, flooding had been controlled and much of the downtown area transformed. The focus for Pittsburgh's Renaissance was the Golden Triangle. My schoolmates and I were given a vision in 1952 by a team of architects that the city would be transformed--and it was. In 1985, Pittsburgh, Pennsylvania was named the nation's most liveable city the the Rand-McNally *Places Rated Almanac.*

Pittsburgh today is the home of 175 nonprofit arts organizations. The arts contribute $121.7 million a year to the local economy, returning to the community eight times their cost of $15.5 million. To Pittsburgh, the arts account for a competitive edge in attracting new businesses as well as the creative professionals who run them.

I moved from Pittsburgh in 1960. After college, I became an arts promoter for Arena Stage, Washington D.C.'s premier repertory company; for the Smithsonian Institution's Performing Arts Division; and the National Portrait Gallery.

Later I promoted international art exhibitions for corporate clients. These included "The Search for Alexander," for Time/Life and the National Bank of Greece, "Northern Lights" for Volvo and the Scandinavian nations, and aboriginal exhibit for Australia, The El Greco Exhibit at the National Gallery. I have been a creative, professional arts promoter for a quarter of a century. An arts addict, I need the arts to live. I recognize the debt I owe to the City of Pittsburgh for helping me get started in the way I see.

As a Professor of Visual Literacy, I think there is a value in teaching a look at the familiar, how it came to be, and how it affected those within its radius. As a city, Pittsburgh benefited from the philanthropic vision of its patrons both in the quality of life and through the creative energies that its institutions attracted.

This past summer, the National Gallery offered a series on cities. Their curator told the story of some of the great cities of the world through looking at paintings. I think the story of a city's impact on an individual is a valid exercise for students of visual literacy. It certainly was for me.

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IMAGERY, SCIENCE
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Visual Links: Discovery in Art and Science

by
Dennis M. Dake

This paper will explore some specific aspects of the relationship between the process of discovery as experienced in art and science. The use of the visual perception system is viewed, in this exploration, as central to discovering the links that exist between the visual arts and the physical sciences. A primary assumption here is that both classes of human endeavor must utilize and depend upon the same visual/brain processing system. Both disciplines, therefore, share a particular imaginative and productive interest in the disciplined use of imagistic thinking. Jacob Bronowski has pointed out the importance of this connection for our educational system. "Science uses images and experiments with imaginary situations, exactly as art does....To believe otherwise, to suppose that science does not need imagination, is one of the sad fallacies of our laggard education." (Bronowski, 1978, p 20)

That disciplined and visually based thought has been utilized to help the scientist discover new knowledge, can be readily seen in the notebooks of inventors such as Alexandar Graham Bell, or of scientists of renown such as Charles Darwin, who frequently sketched an abstract branching structure as he formulated his ideas on biological evolution. When looking at the evolution of visual ideas in the sketchbooks of artists such as British sculptor Henry Moore, one sees the same interest in evolving the structural equivalent for an idea or an experience developing in the mind. Individuals functioning within both art and science disciplines are reaching out to grasp things not currently existing in the world of perception. Many books, scholarly articles, and monographs have been written on this relationship between art and science, but most that were reviewed in the preparation of this paper were found to be heavily dominated by written explanation and quantifiable evidence. They offered only meager visual documentation of the remarkable similiarities between the visual processes and products of creative discovery in the fields of art and science.

Some Interesting Connections

There are many productive interactions between visual artists and scientists, which though they are becoming increasingly prevalent on the contemporary scene are not the particular focus of this discussion.

1. Artists interested in and using science and technology.

For years, contemporary artists have collaborated with scientists and technologists. Of particular note was the EAT group, founded in the 1960's. Today many artists use the tools and knowledge provided by modern science, such as neon lights and computer graphics technologies. Artists have also been interested in looking at the visual phenomena of the scientific world. A particular case in point are the group of murals on the theme of science and industry painted in 1933 in Detroit by the Mexican muralist, Diego Rivera.

2. Influences and interactions of scientists and artists on one another.

From the discovery of mathematical principles underlying linear perspective in the Renaissance to the remarkable common exploration of spectrum analysis and optics conducted in the 19th century by the French Impressionist painters and optical scientists, such as Chevreul, there is a long history of close relationships of influence and common interest between individuals calling themselves artists and scientists. Many have noted the influences of Freudian psychology upon the surrealists in the early 20th century and the effect of the photographic analysis of motion on futurist paintings, such as Marcel DuChamp's Nude Descending a Staircase.

3. Scientific illustration.

Illustrators have been cooperatively working with scientific colleagues for hundreds of years to record and accurately communicate information that can best be understood in a visual form. A great deal of information can be clearly conveyed in an illustration where even a photograph might be confusing. Many phenomena which scientists study are highly abstract and can be best communicated to a lay audience with accompanying visual representations or simulations.

4. Scientific visualization.

Scientific visualization is becoming an increasingly complex and important field in the advancement of science. Individuals with both artistic and scientific training are employed in this field. They frequently use state of the art computer technology to visualize large sets of data and understand the complex interactions. Other scientists work with simpler manual technologies to visualize and explore imaginative relationships within the physical world through physical model making using common materials. Often discoveries are made in this way.

5. Exploration of the properties of materials.

In retrospect, the elaborate techniques which artists have created over the centuries to push materials into forms for expressive and utilitarian purposes, can in the hands of an analytically minded scientist, yield new discoveries on the nature of materials and forces in the physical world. An exhibit of historical objects from the earliest human civilizations, entitled "Aspects of Science", was held at Massachusetts Institute of Technology in 1978. In this exhibit many discoveries which have been directly useful to the development of scientific fields, particularly Materials Science, were displayed.

6. Exploration of information hidden from view.

Scientists in many fields require the use of photomicrography with electron and other devices to reveal important and meaningful structural relationships hidden in the world of the very small. Astronomers use optical and radio wave telescopes to clarify visual phenomena in the world of the unimaginably large. Medical researchers and doctors have CAT scans with three dimensional modeling and Magnetic Resonance Imaging to help them discover truths hidden within the human body, without the need for exploratory surgery.

7. Representation of scientific research results.

Artists are often called upon to design charts, graphs and illustrations representing and communicating the results of scientific research. Clear visual representation of important data and conclusions can carry the messages of science to a distant future.

8. Science fiction art.

Undoubtedly some of the most imaginative of interactions between science and art occur in the realm of science fiction. Movies and television shows, such as the Star Trek or Star Wars series, visualize for a mass audience evidence of the potential for scientific ideas projected forward in time.

9. Visual discoveries outside the boundaries of conscious reasoning.

Perhaps the closest type of science/art interaction relates to the use of automous imagery, such as dreams, in the process of discovery. The best known example from science is the oft cited example of the chemist Kekule reporting that he fell asleep and dreamed of a snake swallowing its tail. Upon waking, this visual configuration gave him the revolutionary structural idea for understanding the structure of certain organic compounds such as the benzene ring. The use of autonomous imagery is, of course, well established in the work of artists, with the dreamlike imagery of the surrealists being the most obvious case.

Remarkable Similiarities

In 1963, *Look Magazine* published a visually interesting article authored by Charlotte Willard, entitled, "How Science and Art are Changing our View of Reality." This article contained several visual comparisons demonstrating the remarkable visual similiarities between what were then some of the most recent "discoveries" in the fields of art and science. For example, an abstract painting by the surrealist, Roberto Matta entitled, "Listen to Living" was compared closely in form with the scientific visualizations of Photothermoelastics researcher, Dr. Herbert Decker. In these visual explorations, both artist and scientist clearly sought to understand the world through similiar flowing organic forms and colors. While the verbal explanations of artists and scientists about their intentions, methods, and purposes undoubtedly vary widely, the visual comparison is striking and not to be denied. Both disciplines look at and manipulate the same visual elements from the same visual world.

A Scientific Basis for Visual Discovery

A factual basis for exploring the methods of creative visual discovery can be found in the literature on lateralized functions of the hemispheres of the brain. Specifically, a 1976 study by Levy and Trevarthen (Springer & Deutsch, 1981) (figure 1) demonstrated that the left hemisphere of split-brain patients tended to select matches for presented visual stimuli (pictures of a cake, scissors and

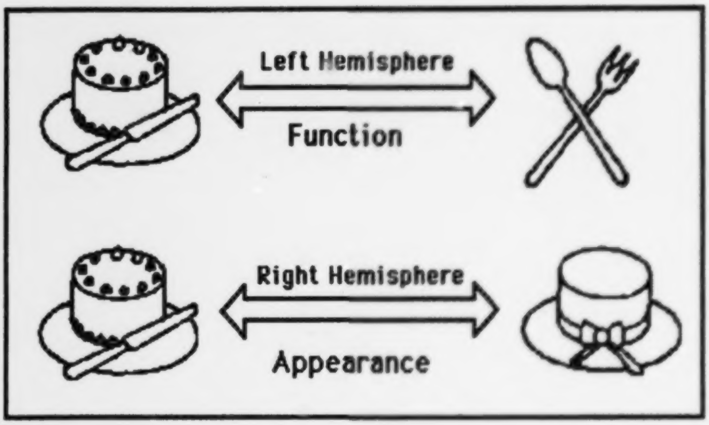


Figure 1: Laterality study for hemispheric functions

glasses, etc.) from a group of other stimuli (hat, spoon and fork, and an arrangement of needle and thread) based on function. For example when shown a cake on a plate the subject selected the spoon and fork as implements with which to eat the cake. Most current intelligence measuring instruments use such visual reasoning concerning function. The study, published in *Journal of Experimental Psychology*, concluded that, while the left hemisphere tends to match by function, the subjects' right hemispheres tended to match by appearance. When the right hemisphere was shown the visual stimuli of the cake, it picked as the "best" match a visually and structurally similiar visual respresentation of a hat with a wide brim. It would appear that this capacity for "thinking by appearance" could be part of the basis for the reported mental ability of creative individuals to make great discoveries by means of imagery alone.

The most famous report by a creative individual of the ability to generate new thoughts by heavily visual means is the Albert Einstein answer to a questionnaire about his working methods. "The words of the language, as they are written and spoken, do not seem to play any role in my mechanisms of thought. The psychical entities which seem to serve as elements in thought are certain signs and more or less clear images which can be voluntarily reproduced and combined ...The above mentioned elements are in my case of visual and some of muscular type". (Ghiselin, 1952, p 43)

Thinking by appearance leads to the abilty to be able to stretch and break traditional conceptual "boundries" around ideas. This boundary-stretching and boundary-breaking confers on the individual the ability to create analogies and metaphors for experience. From this unique new point of view, new discoveries are possible. Arthur Koestler has proposed for this creative thinking ability the term "bisociative thinking". He proposed that this ability is the basis of all creativity whether in science or art. A particularly striking example of bisociation in the visual arts is "Bulls Head" by Pablo Picasso, a 1943 sculptural assemblage of the handlebars and seat of a bicycle, which, when arranged vertically, instantly acquired the gestalt structure of the head of a bull.

Examples of Visual Discovery

Scientists have looked for the perceptually based evidence of discovery by artists for further study by the scientific method. Leonardo da Vinci's journals and notebooks are a particularly rich source of precise visual information. Both scientists and artists can see in this Renaissance artist's visual forms, accurate records of phenomena and relationships of the physical world. One fluid mechanics scientist at the University of Iowa even believes that Leonardo was the first scientist in that field. He uses the drawings of the flows of eddies and tides in the notebooks of daVinci as a research base for advancing fluid mechanics.

The *Look* magazine article mentioned earlier made a visual comparison between a photomicrograph of the DNA modecule created by Dr. Roman Vishniac with the organic form explorations of artist Arshile Gorky. Interest in the structure of the basic unit of life has been present in both scientists and artists. In 1968 Science Digest identified a shaped canvas by Abraham Joel Tobias entitled, "Genesis - Male and Female" as an intuitive visual understanding of the the double helix structure of DNA some 18 years before Drs. Watson and Crick and their team made a spiral model from scientific laboratory equipment to establish the relationships between various available data. This discovery earned Watson and Crick the Nobel Prize. The artist remains largely unknown today.

Look magazine also drew attention to the structure of nonobjective paintings created by American artist Jackson Pollock in the early 1950's. These were compared to the later discovery, revealed in a photomicrograph, of the structure of electrical waves traveling through the cortex of the human brain by D.A. Scholl of the University of London. That Jackson Pollock, using a novel and often ridiculed method of applying paint to canvas, should be compared to the careful and meticulous disciplined work of scientists may seem almost ludicrous in the current cultural climate. However, if we consider that Pollock said his intention was "to paint himself into his paintings," this connection may be seen as potentially more productive. Pollock's methods also grew out of two other sources which establish the connection between his visual explorations and the structure of brain activity. First, he began his nonobjective explorations at the suggestion of his psychoanalyst who felt that, since he was a visual artist, he might better access his stream of consciousness in visual rather than verbal symbols. Secondly, Pollock drew inspiration for his method of applying paint to a canvas laid flat on the floor from his interest in the Navaho sand paintings on the ground. That these sand paintings are created to effect a spiritual and medical cure for an ill member of the tribe creates a rich analogy for the ability to control mental activity, which the personally troubled Pollock would have found compelling.

Two Personal Experiences with Visual Discovery

This connection between visual form and thought is further amplified by two personal experiences of this author. In 1985, after completing a series of paintings (such as the one shown in Figure 2) based on the twisted forms of cloth about to be tie dyed, I learned from a chemist that the forms which I had been exploring were essentially Fractal mathematical structures. When I was shown the computer visualization of a Fractal, (see Figure 3) I had to agree that there was a remarkable similarity between my slowly developed intuitive forms and the symbolizations created by mathemati-

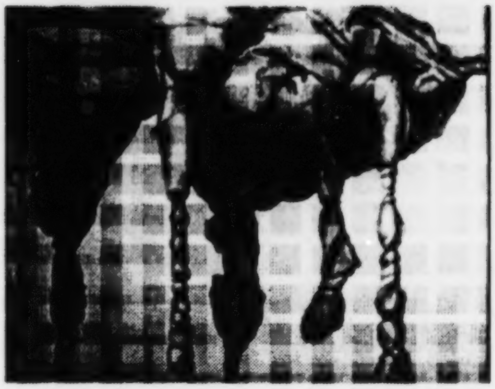


Figure 2: Thought Structure, Dennis M. Dake Watercolor, 24 x 30 ", 1982

cians for their discoveries in assymetrical mathematical equations. That I had from the beginning called the paintings in my series " thought structures" made the metaphor that much richer for me.

A second example which depended upon an appreciation for visual comparison, intuitively arrived at, occurred some 12 years ago as I sat looking at a reproduction of Michaelangelo's "Creation of Adam" from the Sistine Chapel, (Figure 4). The form which has usually been described by art historians as "God emerging out of a void" to awaken a sleeping Adam seemed to me, in a way I could not describe in words, to be strangely familiar; not the logical connection to a void, but to something else. As I stared at the painting, the intuitive thought arrived, seemingly unbidden, that this was the structure of the human brain which I had been studying in the previous months in preparation for a lecture on mental process in art. When I located the photograph of a bisected human brain (see Figure 5) the structural similiarity was astonishing; enough so, that I made

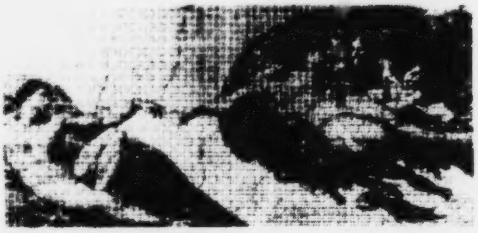


Figure 4: Creation of Adam, Michelangelo, Sistine Ceiling, Vatican, Rome

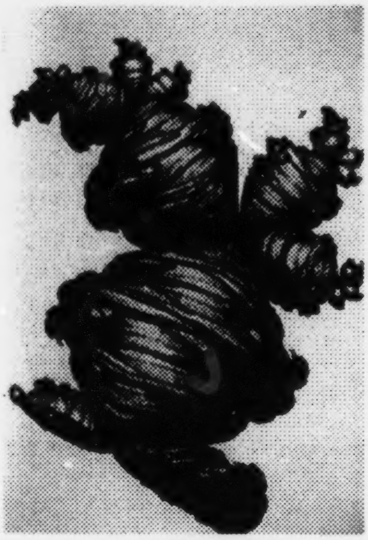


Figure 3: Fractal (Smithsonian Magazine)

Quaterniomic Julia Set by Alan Lorton from *The Fractal Geometry of Nature* by Bemoit Mandelbrot, W.H. Freeman and Co., 1982 - Reproduced by permission.

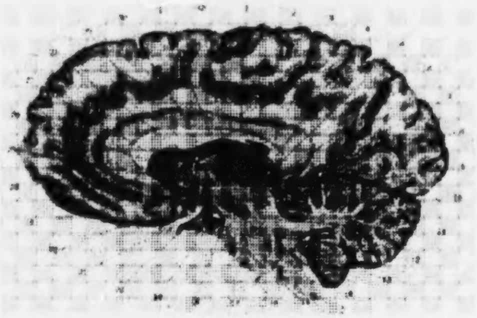


Figure 5: Cross section- Human Brain

Medial Surface of Sagittal Section from *Atlas of Human Brain* by M. Roberts and J Hanaway, Lea and Febiger, 1970, Reproduced by permission.

the visual aid (figure 6) to illustrate the most important structural similarities.

My intuitive conclusion was never published because I felt I lacked the scientific expertise to draw this inference. However, in 1990, a medical doctor came to the same conclusion as I had and published his structural comparison in the *Journal of the American Medical Association* under the title, "An Interpretation of Michelangelo's Creation of Adam based on Neuroanatomy." Dr. Frank Meshberger's careful analysis of structural similarities is quite believable if we factor in the knowledge that Michelangelo was known to have dissected human cadavers to gain knowledge of anatomy.

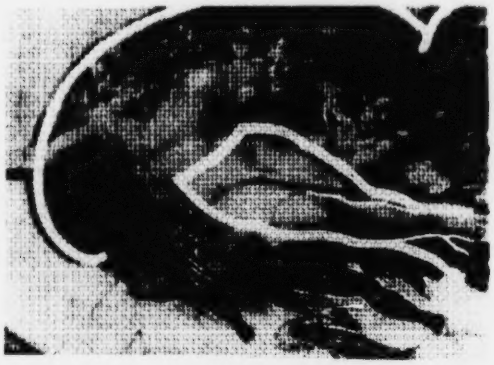
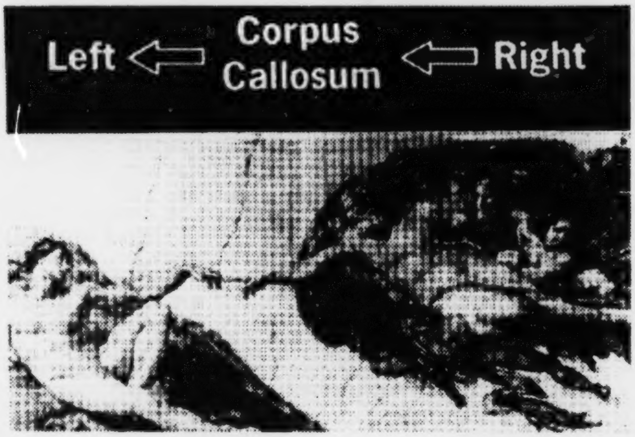


Figure 6: Michaelangelo's form outlined to show structural similiarities to form of human brain. (Original visual,1982)

Within the art history community Dr. Meshberger's thesis has raised a great deal of controversy. Many critics contend that 16th century man could not possibly have had this knowledge about the importance of brain structure. Without conscious intent these critics suggest no visual discovery of knowledge can be attributed to Michelangelo. Given the many clear points of visual comparison made by Dr. Meshberger, it is strange indeed that his paper should have raised such opposition. Perhaps the opposition is so great because admitting to the possibility of knowledge gained by visual means, hundreds of years before it is codified by the scientific community, could lead to some unsettling extended analogies. In Figure 7 I have suggested that if the viewer reads sturucturally the Creation of Adam it suggests that Michelangelo not only knew of the structure of the brain, but also chose very insightfully the right hemisphere of the brain. Contemporary hemispheric laterality studies have suggested that the right hemisphere processes information metaphorically and synthetically. These processes then created the potential for rational, logical conscious thought in humans. The spark passing between the two outstretched fingers passes an electrical charge to an already physically developed left hemisphere (Adam), endowing him with rational reason and consciousness. To quote Bob Samples, author of

Figure 7: Creation of Adam as visual knowledge of Hemispheric Laterality.



the book, *The Metaphoric Mind*, "The metaphoric mind includes rationality, linearity and logic - for it created them." (Samples, 1976, p 60)

The final example of visual discovery is perhaps the most interesting and controversial. In 1907 Pablo Picasso completed a painting which came to be called De Moiselles D'Avignon. It is regarded as the precursor of the revolutionary artistic language of cubism. Several authors have drawn attention to the relationship of cubism to the new physics, which emerged at the same time. (Einstein's Special Theory of Relativity was published in 1905). One of the best known comparisons was presented in a 1949 paper by Paul M. Laporte. Laporte pointed out that the cubist artists' interest in the visual intensity (energy) of their subject form (mass) have their equivalent in the energy/mass relationship of the new post-Newtonian physics. Further, he pointed out that cubism used a simultaneity of viewpoints within a single format to depict multiple movements in space, calling to mind both the time/space continuum and Einstein's assertion that kinethetics, along with visual imagery, were the basis of his thinking processes.

Laporte sent a copy of his paper, "Cubism and Physics", to Einstein for his reaction and reported his response to the thesis in a second paper. The movement of multiple viewpoints suggested by cubism seemed to Einstein to be at odds with the invariance of laws of nature which he had arrived at logically. His conclusion was that, "This new artistic language has nothing in common with the theory of relativity." (Laporte, 1966)

Picasso, in 1972, also took pains to deny connections between art and science. His statement even suggests that it is harmful to art to pursue connections to science. "Mathematics, trigonometry, chemistry, psychoanalysis, music and whatnot have been related to cubism to give it an easier interpretation. All this has been pure literature, not to say nonsense, which brought bad results, blinding people with theories. Cubism has kept itself within the limits and limitations of painting, never pretending to go beyond it." (Ashton, 1972, quoted in Mermoz, 1981) This mutual rebuff, coming so forcefully from both sides of the creative gulf between art and science raises an interesting question: Why do both the scientific and artistic disciplines insist so completely on the mutually exclusivity of their discoveries?

Dominance of Verbal Explication

A second related scientific experiment with split brain patients may lay a foundation for understanding why, with such compelling visual evidence to consider, the conclusions of both scientists and artists reject the possibility of synchronism of discovery. A 1978 experiment by Gazzaniga and LeDoux (Springer & Deutsch, 1981) found evidence of an interrupting and over-riding function of left hemispheric linear logic. When a split brain subject in this experiment was simultaneously shown differing stimuli to the left and right hemispheres of the brain (a drawing of a chicken's head to the left side of the brain and a winter's snow scene to the right side of the brain), matching selections from a group of presented visuals differed depending upon the hand used to point out the selection. The logical left hemisphere directed the right hand to select a drawing of a chicken's claw as the "best match" for the stimuli it had been shown. However when asked by the researcher why the left hand had alternatively selected as "best match" a picture of a snow shovel, the subject answered, "to clean out the chicken shed." The obvious visual based logic of needing the shovel to clear the snow covered sidewalk was not consciously apparent to the subject.

Gazzaniga and LeDoux concluded that this over-riding system has evolved to help us "construct a reality based on actual behavior" and thereby see ourselves as single, purposeful beings. It appears then, that the verbal processing portions of the left hemisphere of the brain do not always know the origins of our actions or the meanings hiding behind appearances. The right hemisphere's ability to think by appearances serves as a complementary intelligent function of the mind to counterbalance the dominance of one brain system. Without this complementary balance, the picture drawn in table 1 comes, in our culture, to be the chauvinistic, executive controlling view of the left hemisphere.

Table 1: A View of Art and Science from the Left Hemisphere.

SCIENCE	ART
Precise	**Diffuse, vaguely enriching**
Rigorous	**Playful only**
Objective	**Subjective**
Explicit definition	**Evocative spirit**

This one-sided view leads to a decidedly restricted line of inquiry into the creative functions of the human mind. This view holds that only that which can be explicitly stated as intentional can be accepted as a legitimate, intelligent function of mind. As evidenced from the dismissive quote from Picasso, most artists have not tended to think in terms of scientific theories or even always with conscious attention. Following the purely visual exploratory discipline of painting, drawing, or sculpture, artists intuitively pursue visual form knowledge for its own sake, foregoing verbal explication.

The problem with intentionality as the sole governing principle for visual meaning was clearly stated by Rudolf Arnheim in his analysis of Picasso's painting Guernica. "....it will be evident that deliberate, conscious reasoning and decision constitute only small fragments of the total process, and that therefore any psychological investigation is bound to describe happenings of which the person himself was not aware. The assertion that the 'artist never thought of this' has no bearing on the validity of the interpretation, since the artist, like any other person, does not know what he thought below the level of awareness." (Arnheim, 1962, p 17)

Given the current state of understanding of this lack of cooperation between these two functions of the brain, and given the imperialism of the linear, verbal left hemisphere, it appears that the potential for visual metaphoric discovery is often downgraded and the forceful separation of art and science disciplines is maintained. In his 1976 book, *The Metaphoric Mind* author Bob Samples drew attention to this problem for modern life.

"Albert Einstein called the intuitive or metaphoric mind a sacred gift. He added that the rational mind was a faithful servant. It is paradoxical that in the context of modern life we have begun to worship the servant and defile the devine." (Samples, 1976, p 26) This sadly seems to be the state of understanding within western culture, where the historic understanding of synchronistic visual discovery is not valued or promoted. Perhaps the uncertainty principle of physics (phenomena are altered and accuracy of measurements made more uncertain by the very presence of the observer) applies to the verbal, analytical processes when attempting to explore and understand the processes of visual discovery.

Synchronism: A Visual Way of Knowing

This paper proposes a scientific/artistic way of knowing as distinct from analytical proof, logical understanding or purely subjective reactions. Jacob Bronowski again lays out the agenda in stark terms, "The human mind works with images, and even its most subtle ideas have to be composed from images. We cannot form any theory to explain, say, the workings of nature, without forming in our mind some pattern of movement, some arrangement and rearrangement of the units, which derives from our experience." (Bronowski, 1978 , p 28)

This "scientific/artistic way of knowing" begins with an increased ability to visualize, meanwhile, learning to live with the inherent ambiguity of all visual form. Both artists and scientists are aware that this way of thinking must be solidly grounded in aesthetics. Both groups must develop their ability to process ideas in visual, structural terms in order to think their way into unknown situations. The synchronistic way of knowing concentrates on the visual, imagistic formation of ideas, informed by critical thinking, and leading to a type of purely visual logic. This type of thinking stimulates productive thinking leading to meaningful outcomes that demonstrate the historic interconnection between truth and beauty. There does remain the compelling question: "Will our verbally based, analytical culture ever adequately recognize, develop and utilize the potential of the visual mode of discovery?"

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Technology and Art: A Postmodern Reading of Orwell As Advertising

by

Shay Sayre and Sandra E. Moriarty

Postmodernism provides a window of study for art, architecture, philosophy, politics, media, literature, and consumer culture. Modern and, to some extent, postmodern imagery focuses on science themes using symbols that characterize the machine, computer, and information ages. Little research has been conducted, however, analyzing advertising's use of postmodern themes, particularly its artistic use of scientific imagery. Furthermore there has been little research which takes the analysis of modern and postmodern imagery a step further and seeks to understand how consumers interpret modernist and postmodernist themes through their own readings of advertising texts.

This paper analyzes Apple's "1984" com-mercial developed for the introduction of the Macintosh computer to compare both the production and reception of modern and postmodern imagery by a group of contemporary viewers. The "1984" commercial was based on an adaption George Orwell's famous science fiction story titled *1984*. This paper analyzes the use of this novel as a theme for a new product introduction and the use of cinematic artistry to provoke the imagery of a postmodern vision of a technologically driven future.

In the TV ad produced by the Chiat-Day advertising agency and film producer Ridley Scott for Super Bowl viewers in 1984, George Orwell's chilling futuristic story was re-adapted to commercial use in a postmodern style. In what Kellner et. al.(1984) called a "negative utopia", indusrial mass production and a controlled society is revolutionized by the innovation of a new computer. A female metaphor for Apple challenges the totalitarian leader (read IBM) and, in the end, consumers can be seen as released from the bondage of hostile technology through the friendly Macintosh.

Modern and Postmodern

Various scholars have written on the definitional problems of the concept of *postmodern*. (Rose, 1991; Featherstone, 1991; Jencks, 1985) It is the nature of the term that it has to be defined by its contra-positional relationship to *modern*. While on one hand it can mean subsequent to or following, it also refers to the set of eclectic stylistic details that contrast with the spare, functional designs of the Modernist or International Style. On a larger plane it conveys its theorists' views of the failures of a science-based industrial society.

Definition, then, must begin with *modern* ideas about society and culture which reflect industrialization, technological development, and scientific progress. The modernist's optimistic view of science as bringing improvements to individual lives and society, intertwines with a fascination with new technology. The "canon of modernism" is capitalism and progress. Modern images are functional, streamlined, futuristic, and mechanistic.

A counterpoint *postmodern* theme shows up in works like Orwell's *1984* which see technology as repressive and antihuman. They see the negative side of modernization and their images of modern society symbolize alienation, anomie, anxiety, anger, depression and repression, isolation, fear, self-destruction, and neurosis. On one hand, postmodern critics see the modern world through a filter of pessimism, but, on the other hand, they bring a new vitality to humanism and turn to the streets and popular culture to celebrate a diversity of styles, historical borrowing, and a richer aesthetic life. Postmodern uses a variety of codes that "live across time" in a "pastiche of value-laden styles."

Orwell's *1984* is a good example of the negative view of modern society as imagined by a postmodern critic. It is a nightmare vision of the future, a high-tech society populated by mindless clones who represent programmed humans trapped in their inability to act alone and think on their own. And yet Apple's solution to this dreadful situation is a computer, a scientific breakthrough that, in the best traditions of modernism, liberates the workers from the drudgery of their daily lives.

Postmodern theorists are often influenced by the political economy and Marxist schools of thought with their criticism of advertising as the flag-bearer of capitalism. According to McGowan (1991), an unthinking acceptance of con-sumer capitalism "links advertising with the totalitarian watchword" which induces a similar passive acceptance in the populace; a deformation of the signifying order. (p. 34) The theme of this commercial reflects Denzin's (1991) claim that commercial culture will "expose the oppressive limitations to freedom" that characterize the cultural logic of late capitalism (p. xi)." Derrida (1967) sees products, as well as advertising messages, as texts that are a rich reservoir of diverse meanings.

Reception Analysis

In poststructuralist theory, the individual viewer/reader is the final author of the meaning; therefore, there is a need for reader-response research to better understand the personal and idiosyncratic range of meaning produced by the varied readers of an advertisement. The most fundamental assumption shared by reception theory critics, who conceptualize the process of reading or viewing as a socially situated discourse (Jensen & Rosengren,1990), is that meaning comes from the interpretation of the reader rather than something that resides in the text (Allen, 1987).

Polysemic Meaning The idea that different readers get different meanings from a text, or the polysemic nature of meaning, is at the heart of the poststructuralist's criticism of effects and formalist studies. Literary explication often focuses on the multiple layers of meaning in a text. With reception theory, the focus turns to the multiple meanings perceived by the readers, or in this case, the viewers. Multilayering is an important message structure used in advertising because it makes it possible to communicate complex ideas in a restricted time and space. Peterson (1987) said that advertising's use of multilayered stories places new demands on recipients, and in turn the recipients supply new forms of interpretation.

Eclectic Viewing The reader's task, according to poststructuralism, is one of production rather than consumption, a process of dismantling and reassembling the thoughts and concepts to create a personal "reading" of the meaning, and literally "rewriting" the text in the process of making sense of it. The poststructuralist position is that meaning is not autonomous in the text, but created anew in every reading (Berger 1982, p. 35). Poststructuralist research into the meaning of an advertisement, then, focuses on varieties of meaning produced by the audience.

Similar to the effect of a John Cage musical experience, or the outcome of Jackson Pollack's "action art," television viewing in the 1990s has become a schizophrenic experience, a mixing of codes, and a violent overlapping of images. Viewing can be conceptualized in Rose's (1991) terms as a new pluralism, piecemeal thinking, and ultimately radical eclecticism.

Radical eclecticism is experienced by all television viewers, including those viewers of Super Bowl who provided a viewing arena for the "1984" commercial. Through the clutter of unrelated messages juxtaposed by time and content, the viewer must make sense out of the image-intensive experience.

What follows is a sample of the types of images a viewer encounters during the two or more hours of typical Super Bowl entertainment: musical extravaganza ads for Coke, instant replays of a lineback's fumble, a five second news flash on flooding in California, previews of an upcoming network science fiction movie, highlights from past Bowl games, Nike's animated character (Hare Jordan) accompanying human Air Jordan in a basketball commercial, multiple network identifica-tion breaks, three Bud Bowl playoffs, numerous player profiles, the invasive Energized drumming rabbit marching through a parody of a commercial, a news brief about fighting in Israel, Murphy Brown stars promoting their next episode, Heartbeat of America ads, a viewer sweepstake game, a weather advisory. . . . and occasionally, the game itself.

In this polysemic blend of action, news and discourse on consumption, "advertising tends to function as backdrop, a reassuring litany of interwoven signs, into which the vicissitudes of the world are inscribed as a diversion." (Baudrillard 1990, p. 87). Like listening to Cage's music, the act of viewing becomes an eclectic experience which superimposes past and present, real and fictional, upon a structure of advertising intermissions.

With personal interpretations and a complex nonverbal message comes the opportunity for idiosyncratic meanings that deviate dramatically from the author's intended meaning, and may even approach a state of total misinterpretation. The semiotics expert, Umberto Eco, notes this problem and describes aberrant decoding as the rule in mass media, a warning which should give advertising experts reason to pause (Berger 1982, p. 35). While poststructuralists see idiosyncratic meanings as an indication of receiver creativity and engagement with the message, advertisers see them as message, and possibly advertising, failure.

Structural Analysis

Structuralism focuses on the form of the message as it looks for universal structures such as narratives and myths that are basic to cultural understanding. Poststructuralism is less concerned with the idea of dominant forms and narratives and more interested in multiple meanings and marginalized themes.

Intertextuality A concept important to poststructuralist meaning analysis is intertextuality, which refers to the fact that one story may convey meaning by referring to another story; the co-presence of two or more texts. This is important because Jencks' definition of postmodern is "double-coding," meaning that one theme or style is embedded in another. (1985) With Jencks' definition in mind, the "1984" commercial is a classic example of a postmodern message strategy.

An intertextual logic governs the basic structure behind the "1984" commercial. It announces the introduction of a new product, but that product launch message is embedded within a science fiction storyline. It also implies an association between IBM and Big Brother and between Apple and the woman hurler who destroys the Big Brother imagery. Furthermore, this complex narrative is constructed through visuals; essentially this is nonverbal communication with words used only to symbolize ideological rhetoric.

Simulcras The disconnectedness of experience relates to Jameson's other feature of the postmodern, the transformation of reality into images. Baudrillard's (1981) simulcra, the imagery which is more real than reality, is particularly evident in the characterization of the electronic Big Brother. Akin to Jameson's philosophy and to

Baudrillard's discussion of postmodern imagist culture, this commercial's message is communicated entirely through its "visual rhetoric." (Scott 1990)

Semiotic Meaning

Culture interacts with advertising to create meaning in products as well as in messages. John Sherry (1987) explains that, "as a form of metacommunication on the order of myth and ritual, advertising works at the level of semiology to invest goods with meaning." Semiotics, perfected by Barthes (1989) and skillfully applied to advertising by Williams (1974), has been found to be an effective method to deconstruct symbols and signs in texts. Playing to marketing-oriented consumers, advertisers are specialists in symbolic production who construct cultural readings of social themes--power, class, race, gender, revolution, success, and happiness (Denzin 1991). Their work provides an ideal forum for the deconstruction of symbolic meanings using semiotics.

There have been two interesting efforts using semiotic approaches to explicate meaning in Apple's "1984" commercial. Berger (1989) provided a synopsis, background and interpretation of the main images and symbolic meanings found in the commercial. Scott (1991) performed close readings of the various messages which can be interpreted from the ad.

Berger used oppositional patterns to detect meaning, a method derived from the ordering of the elements of meaning in a narrative as expressed through diachronic analysis which looks at the structure and order of the narrative. A semiotic approach to deconstructing meaning is to take it apart in terms of its basic logic. Semiotics provides clues in how to analyze the form and logic of its oppositional structures. As Berger (1982) explains, the basic relationship in meaning is oppositional. In other words, like definitions of postmodernism, we define and know something in terms of what it is not--so a semiotic interpretation will look for synchronic patterns that can be expressed as bi-polar oppositions.

Oppositions A postmodern analysis of the commercial "1984" presents it as a confrontation with contradictions. Contradictions, according to Denzin (1991), are the interpretive accounts that allow individuals to come to grips with the contemporary world . . ."cultural practices, which turn on pastiche, parody and the effacement of the boundaries between the past, the present and the future, must be connected to contradictions in late capitalism (p. 12)." "Postmodernism," says Hassan, veers toward open, playful, optative, disjunctive, displaced, or indeterminate forms, a discourse of fragments, an ideology of fracture" (Rose 1991, p. 52). Among his long list of postmodern dichotomies are: narrative/antinarrative, form/antiform, hierarchy/anarchy, and determinancy/interdeterminancy.

In the "1984" commercial, dichotomies are well crafted by Chiat/Day, the advertising agency who produced the spot for Apple, by emphasizing desire rather than the ego, heros versus antiheros, freedom and liberation versus control and domination, an individual versus the mass, and images rather than words.

THE STUDY

In addition to interpretive analyses of the modern and postmodern elements, this study also focused on viewer perceptions of the meanings of the commercial.

Methodology

Interpretive consumer research, now established as a legitimate discipline (Mick, 1988; Sherry 1987), has enabled advertis-ers to better understand the cognitive processing of their audiences and can serve as a logic of discovery. Equipped with a library of advertising culture, consumers possess an attitude of reception that is aesthetic, skeptical, and ironic, as expected of postmodern audiences.

According to Stern (1989), the application of literary criticism to advertising text can enhance knowledge of consumer behavior. Interpretive analysis can also be used to deconstruct meaning in the message by explicating themes and the appropriateness of the various symbolic meanings used by consumers.

Respondents The viewers were 200 undergraduate students in introductory mass communication courses at two state universities in the western U.S. Clearly the audience is different in many ways from the original audience; but the point of this study is to analyze the production of modern and postmodern meanings by viewers---not copytest the commercial for its effectiveness---so these audience differences are not seen as critical for this particular type of analysis.

In class, the situation surrounding the viewing of the commercial was explained and the assumptions made by the creative team about the knowledge level of the target audience were also noted. Fewer than 5% of the student viewers had seen the commercial previously, and none had seen the original broadcast.

Using a form of modified thought-listing, the response form asked viewers to explain the meaning of the commercial and what the various symbols and images represented in their own words. Their responses were coded using a form of interpretive content analysis with the categories determined by the message elements and oppositional structures identified in interpretive analyses of this commercial by Berger (1989) and Scott (1991). Beyond the categories, words and phrases of identification and description were identified as representing either intended or idiosyncratic meanings and modern or postmodern themes.

FINDINGS

One aspect of postmodernism hails the demise of the predictable dominant narrative form, however it also recognizes metanarratives that drive individualized or marginalized interpretations, such as cultural myths which transcend region and locale. Postmodern cultural heroes, defined by race, gender and income, are often electronically connected to the modern narrative of "the American dream." (Denzin 1991). In "1984" the American Dream of progress through technology turns into a nightmare but the hero, or in this case the heroine, saves us with a computer that will liberate the mindless.

Metanarratives We can identify a series of other metanarratives in "1984", including David and Goliath, feminism, future visions (or science fiction) in the viewers' idiosyncratic interpretations. As noted by Lyotard (1984), past discourse predicated in reason, science, and truth (modernism and empiricism) has been replaced with a new system derived from the structures of narrative knowledge lodged in everyday life, folklore, myth ideology and folk heroes. Science fiction, the old modernist narrative, now looks quaint when compared to postmodern eclectic imagery.

The commercial is a set of layered metanarratives, driven by the David and Goliath myth, as noted by Berger, that makes complex demands on viewers' meaning production. It is reinterpreted from this mythical narrative to images of an electronic (un)reality and then redefined at the end as an advertising sales pitch for a new product.

Intertextual Themes The viewers' responses can also be analyzed in terms of notions of intertextuality and the relation between the master narrative and the embedded metanarratives. In terms of how the viewers perceived the basic intertextual logic, 48 percent focused on the product introduction story in their retelling of the meaning of the commercial, while only 10 percent focused on the *1984* storyline. Another 33 percent noted both stories and referred to them equally in their discussions of the commercials meaning. Clearly the product introduction message, as obliquely presented as it was, did not get lost in the dramatic imagery and narrative of the original story.

One of the metanarratives mentioned by Berger described the woman's role as David (David and Goliath myth) destroying the power of the giant. None of the viewers saw that meaning in the commercial, although several of them did see her as a 'destroyer' (6) or 'destroying old ways' (2). Another Berger metanarrative was the mythic hero; five students did see her as the 'hero,' 'white knight', or 'Thor.' (Note the gender change in some of these identifications.) Seven others said she was the 'savior,' three said 'leader,' and others called her a 'liberator,' 'rescuer' and 'last patriot.'

Another small group of viewers saw her as either a feminist or a sexist image. One viewer, for example, in a completely idiosyncratic reading, referred to her as a "Hooter's Chick."

Of note here were several intertextual relationships mentioned by students. One which stands out were the references to Hitler, Nazis, concentration camps, and communism. Perhaps the disintegration of Eastern Europe and the resurgence of the neo-Nazi party caused these viewers to make references from another time and place. One student thought the runner had a Nike shirt on, and another thought the ad was for Nike shoes. These references to another commercial are indicative of layers of meaning accumulated by the postmodern commercial viewer.

Eclecticism In the Macintosh commercial, some message elements were interpreted by viewers in much the same way as the producers intended and in line with the interpretations of Scott (1991) and Berger (1989). The elements that contained the most agreement were: Big Brother's message which represented ideological doubletalk (76% agreement), the woman who was seen as symbolizing resistance or Apple (73%), and the setting of tubes and tunnels which represented control and conformity (64% agreement). While there was a great deal of agreement on these elements, they also carried some interesting idiosyncratic meanings. The woman runner, for example, was seen as Eve, a feminist symbol as well as a sex symbol ("Hooter's Chick"), a patriot, a bolt of lightning, and a mythical hero (Thor, white knight). An intertextual reference was apparent in the response of one who saw her as a figure from a Nike commercial.

Those elements that received less than 50% agreement on meaning and therefore carry more idiosyncratic interpretations include: the clones or automatons who were seen as representing brainwashed society (48%)--other meanings included modern American society, skinheads, computer illiterates, IBM users, U.S. businesses, and TV viewers. Big Brother symbolized a totalitarian despot to 45%, however other interpretations included a bureaucrat, Hitler, IBM and other computer companies. The police were seen as opposition to change by 40%, however the other meanings included capitalism, communism, big companies against change, Nazis, and sexist forces.

Oppositions After reading the viewers' analysis of the commercial, coders noted bipolar opposites contained in those comments. In addition to the 18 bipolar opposites coded according to Berger's semiotic analysis, 137 different con-cepts built on bipolar opposites were found in student responses, another measure of the eclecticism of viewer responses. A close reading of the analysis of the "1984" text by Berger and Scott and comparison with the viewer's responses revealed a set of six basic oppositions which seemed to dominate most of the interpretations: past/future, optimism/pessimism, friendly/unfriendly, liberator/controller, freedom/totalitarian, individual/conformity, and rebellious/passive.

Past and Future This commercial calls upon the viewer's understanding of all levels of narrative structure and, in particular, to the strange manipulation of time by which the present becomes intermingled with both past and future. In this narrative time warping adds to the sense of unreality. What is then (past), now (present) and the future?

The uncertainly of time arises from a confusion among the images of the past (slaves, Nazis, Hitler, the monumental gothic meeting room), the future (Orwell's all-knowing ruler, the Darth Vader police, video-techtronics, science-fiction, futuristic setting) and the present (the contemporary woman and her clothes, the hammer). The viewer is teased with glimpses from all worlds without a grounding in any one perspective in time.

A process of 'circling back' (Denzin 1991) to an earlier cultural form and attaching it to a new commodity is evident in "1984" which uses a well-known, but old, piece of science fiction to introduce a new product. The outcome is a new form of signification which, as Denzin explains, "invokes the cultural nostalgia for an earlier form, resurrecting the cultural memories of that form and its moment while attaching a 'purified' cultural ethic to the new object. It places the newly advertised object in a seamless present which extends, unbroken, into the past."

The commercial also reflects the political neoconservatism of the 1980s with its emphasis on a romantic nostalgia for the past, and a general effacement of the boundaries between the past and the present that set the stage for a return to a new traditionalism in American life (Denzin 1991). This coincides with what Jameson (1984) identifies as a basic feature of postmodernism: the fragmentation of time into a series of perpetual presents. His paradigm is the breakdown of temporality, memory, and sense of history (Featherstone 1991).

A time of economic growth, rampant consumption, and repressive politics, the eighties provided a perfect arena for Apple's announcement. The growing nostalgia for the past, might be interpreted as a manifest sign of the declining rate of creativity in late capitalism (Huyssen 1984, p. 57). Or could this circling back signal a legitimate dissatisfaction with modernity and a perpetual integration of forms in the quest for a postmodern alternative?

The smashing of Big Brother's image in "1984" represents an end to the old time (of science fiction) and the beginning of the time of freedom (freedom like we used to know in the past). The scenario suggests that we may be nostalgic for this new future/past-time, similar to the feelings expressed in the first line of science fiction film, *Star Wars* : "Long ago and far away . . " or in the phrase, "Space: the new frontier." In this commercial, science fiction becomes historical truth.

The analysis also looked at the viewers' understanding of time and the time contradictions. Of the 200 respondents, 61 (31%) had some notion of old vs new or now vs the future. Specifically 11 (5.5%) mentioned the future and 15 (7.5%) talked about a new age or new era. In terms of specific notice of time contradictions, however, few were aware of time shifting or time tension, although several did talk about a "grim future," and that departs from conventional texts where grim is usually associated with the past.

As part of their discussion of images and their meanings, viewers made time contradictions when referencing Big Brother. Several viewers attributed his meaning to 'the old order,' and 'hate meetings,' of the past; others said he was 'the future.' These references are juxtapositions of the implied futuristic science fiction genre with images of the historical past of Nazis and concentration camps. Other references indicated that viewers saw the runner as the future, clearly oppositional in time to the captives of computer technology who were intended by the authors to depict the past under the domination of IBM.

Technological Optimism/Pessimism

An interesting question about meaning in the "1984" commercial revolves around its conflicting presentation of technology. Modernism worshipped technology and industrial development and looked to science and progress with optimism. Science and technology were friendly. Postmodernists criticize the dehumanizing aspects of technology and detail the negative effects of machine and computer culture as hostile to humans. In particular, new social movements under the postmodern umbrella protest the rigid rules and programmed lifestyles of the technocrats, a message that is clearly embedded in the "1984" commercial.

Hidden within the "1984" master narrative, is an advertising message about unfriendly (IBM) vs friendly technology (Macintosh). The ad suggests that we are in the midst of Baudrillard's (1988) age of "hyperreality", governed by a new technology in which cybernetic systems have the power to organize everyday life in either programmed or flexible forms. If hyperreality infers that the sign is reality, then the Apple logo becomes consumer salvation through friendly technology.

Clearly Orwell's message was postmodern, but one wonders how that message can be adopted--or coopted--by a computer company. How can a computer company align itself with viewpoints protesting technology? The computer is, after all, the symbol of technology in our time. The ideal that a computer company can be humanistic is a very complex and contradictory concept to postmodernists.

The commercial uses an argument against modernism's hidden dependence on the machine metaphor to mask its message, mixing codes to simultaneously condemn and encourage different brands of the same product category. Apple's logo is a metaphor for freedom, the antithesis of the view of computer as programmed state which is also presented in the commercial. The ad can also be framed as a battle between modern (IBM) and postmodern (Apple) elements of society in which the latter emerges victorious.

In terms of the friendly/unfriendly imagery, 8% of the viewers mentioned friendly technology or computers and 14% mentioned unfriendly technology or computers.

But did the viewers understand the more complex double-coding of technology as capable of being both a negative and a positive force? Can a computer company be successfully associated with a humanistic anti-technology message that exalts freedom and challenges the idea of a programmed state? Pieces of these messages showed up in a number of responses. The idea of a gigantic, super-powerful, bureaucratic company (IBM) vs a small, humanistic, open company (Apple), was noted by 12 (6%) of the viewers. The complex idea that a computer company was sponsoring a message of freedom as opposed to programmed behavior was expressed in different ways by 20% of the viewers using the following patterns of opposition: 'conformity' vs creativity (4), vs differences (4), vs change (4), vs innovation (5), vs breaking the mold (5), and vs breakthrough (4); controlled vs rebelling (2), and vs breakthrough (1); 'captive' vs change (3); and 'followers' vs breaking the mold (2), and vs breaking the norm (3).

Liberator and Controller Postmodernism is more than a response to the unfolding logic of late capitalism, it is also a study of power relationships. According to Jameson (1991), postmodernism traces a "simultaneous collapse and resurgence in popularity of old metanarratives concerning peace, freedom, communism, worldwide democracy, the 'end of history,' patriarchy, racism, and colonialism." In the commercial, themes of dictatorship, patriarchy and racism are certainly implied through Big Brother (dictator), a ruling male, and white dominance--the traditional faces of power in a society.

The conservative aspect of postmodernism that focuses on the dissemination of symbolic goods, which can be understood in terms of changes in the power-balances and interdependences between groups, directly relates to the political tensions suggested in "1984." Apple's transformation of society will bring about a change in power balance; at the same time, the commercial contains overtones of the neoconservative belief that politics must be kept as far as possible from the demands of moral-practical justification.

Are viewers sensitive to these concepts of the changing balance in power relationships? Power, and particularly control (9.5%), were mentioned a number of times in the viewer's responses and 34% did note the captive/liberation relationship. A number of these readers'comments contained the idea that the woman's role was to overthrow the power and control represented by Big Brother. The notion that Macintosh was liberating was found in only 7% of the responses.

Freedom and Totalitarianism. Nine (4.5%) of the responses indicated some sense of a collective tyranny or controlled state. Certainly the woman represents freedom and creativity (the modern view) and the masses represent robots and automatons under the control of a totalitarian regime (the postmodern view).The notion that the woman represents freedom and creativity and the idea that the masses represent robots and automatons under the control of a totalitarian regime was mentioned by 34% of the viewers. In a slightly different view, 7% of the respondents were focused on the idea of a change agent, either the woman or the Mac bringing a new way of doing things; 16.5% mentioned 'change' within the context of their narrative analyses.

One of the rules under attack in postmodern advertising is the dominance of the product presentation, a doctrinaire approach to message design based on linear thought directed by transmission theories. As Sorgem (1991) explains, "In postmodern advertising, the reality of the product no longer provides a foundation" (p. 8). While this sounds like heresy to most advertisers, it does lead to a more involving relationship between the receiver and the message. This, in fact, is what is happening in the "1984" commercial where the receiver is involved in puzzling out the meaning of what initially is a very ambiguous presentation and where the viewer must create much of the new product introduction message.

Individualism and Conformity In the commercial, the passive media-addicted clones of the commercial are connected to our desire for individuality, which is most certainly the stuff of the country's dreams. The woman represents individualism, as well as rebellion against their conformity.

However, there are contradictions in the notion of rebellion in a consumer society as depicted in this commerical. The commercial is representative of "the theories of resistance that are lived by ordinary people in all its eclecticism and variety of voices (Denzin 1991, p. xi)." This story of resistance is typical of the 'feminist cultural studies' theory of Foucault's (1982) micro-politics which sees 'networks of power-relations subsisting at every point in society (Conner 1989, p. 225)."

Yet the symbol of resistance to commercialism is itself an endorsement of consumption. The message tells consumers to think for themselves at the same time it directs them toward a product. Viewers are directed not to follow the competition, rather to follow Apple and buy a Mac.

The idea that the woman represents individualism as well as rebellion against the conformity of the masses was noted by 43% of the viewers. How did viewers respond to the idea that they were being encouraged to be free (think for themselves, don't follow others) at the same time they were being encouraged to buy a product?

*Male and Female.*Using a story about power, the commercial presents a female youth to symbolize resistance and revolution---a non-traditional postmodern approach for a patriarchal consumer culture message. If, according to Denzin (1991), women are the bearers of freedom then this commercial's use of a female metaphor for Apple, makes sense.

Is the blonde runner (Eve) who brings freedom to the technology-bound synonymous with the seductive strategy of advertising that exposes the drama of communication to seduce the postmodern consumer? The Eve-Apple connection certainly suggests a seduction. The ad's gender substitution (female for male as a symbol of power) risks awakening all kinds of sexual overtones; on the other hand, the genderless clones may suggest a feminization of the American public self. The latter thesis arose from evidence that feminism has been alone in attempting to envision the Utopian languages spoken in societies in which gender domination and inequality would have ceased to exist.[1]

The ad reveals an indifference to sexual differences by presenting clones; their presence is indicative of the uneasy encounter between feminism and postmodernism. However, the commercial seems to move in the direction of the feminist approach to postmodernism which argues that a systematic deconstruction of cultural myths about women must occur before inequality will disappear; this argument is made here without incorporating the violence usually representative of feminist statements in postmodern text. The commercial's juxtaposition of gender roles presents a situation in which one sign functions as the interpretant of another and is subject to change without notice.

This commercial was filled with postmodern gender imagery and it was clearly noted by many of the respondents. The biggest area of consensus in the meanings produced by the viewers was the specific noting of the woman's gender: 84.5% responses contained that element. In terms of oppositional structures, the idea of the genderless clones saved by a female figure was noted by 42% of the viewers. The idea of dominated and depersonalized males in contrast to a free, strong female was noted by 44.5% viewers.

Postmodern Advertising The traditional postmodern view of advertising as the spear-carrier of capitalism reflects a level of cynicism that, as one might expect, was not apparent in the viewer's responses. Only six (3%) of the viewers responded with any com-ment sprecifically related to an appeal to buy the product, an indication that, as one might expect after viewing the commercial, the sales dimension of the message's meaning was not very strong. And none of these six viewers who were conscious of an appeal to purchase were able to express a sense of contradiction in the freedom/individualism message being produced by a computer company. It should be noted, however, that Apple's overall message of the introduction of a new product was mentioned by 85 percent of the viewers and it dominated the readings of 48 percent, so the big message of the product launch definitely did not get lost.

Conclusion

The "1984" commercial is an interesting example of the conflict between modern and postmodern messages. In true postmodern style the commercial often says one thing while meaning another: it suggests that the future world will be dominated by unfriendly technology at the same time presenting the Macintosh computer as a friendly antidote to that vision. It suggests that while computers can make people programmed robots, the Macintosh will make them free and creative. In advertising terms, the commercial is "selling against its category," an extremely difficult message to communicate that requires that the audience sort through multiple levels of ironic meanings.

This analysis of responses to the commercial strongly suggests that viewer interpretations noted a number of postmodern elements: in particular, the responses contained many oppositional patterns and revealed a tendency toward eclectic and idiosyncratic meaning, particularly in the interpretation of certain message elements such as Big Brother, the police, and the setting. More than half were aware of the counter positioning of freedom and totalitarian symbols. Almost half noted some conflict between individualism and conformity and that same number noted the reversal of gender roles. Only one fifth, however, had some sense of the conflict between friendly and unfriendly technology. On the other hand, although a third noted the time element, few were able to articulate the past/future contradictions.

While these comments generally tended to reflect postmodern reading strategies, the post-modern elements were also the ones with the most frequent mentions.

For example, in the clash between control and resistance, 49 percent noted control or some aspect of it such as brainwashing and indoctrination while 4l percent noted the resistance, revolution, rebellion factor. In other words, viewers seemed to be more impressed with the negative aspect of the controlled society, which is a typical postmod-ern reading strategy. The same pattern showed up in the confrontation between notions of conformity and individualism and unfriendly and friendly. In both of those oppositional sets, the viewers were more likely to load their interpretations on the side of conformity or unfriendly which are more typically postmodern readings.

However in the contrast between totalitarian and freedom, the opposite interpretation can be seen with freedom receiving more mentions, reflecting a modernist view of technology. Of course, that was the positioning strategy behind the Macintosh message, so it is a testimony to the success of this commercial, that the freedom message separated itself from the overwhelmingly post-modern reading orientation with its critical view of technology.

While this interpretive analyses of viewer readings found a plethora of idiosyncratic meanings, it also found an astonishing lack of sales message elements. Could this mean that '90s consumers, weary of being pitched to buy products, prefer to embrace a product-absent metanarrative and respond to advertising that maximizes its entertainment value? Does the presence of intertextual references evidence a spectrum of unintended advertising messages that are beyond the control of the commercial's author/sponsor? Only further research can respond to those questions; and only through a qualitative investigation of commercial readings can the richness of viewing be appreciated for its contribution to understanding the postmodern consumer.

Finally, in the analysis of the artistic tension between the two stories--the use of an artful science fiction narrative to communicate the idea of a friendly computer and the use of chilling visual artistry to communicate the imagery of an unfriendly world--the friendly computer story seemed to dominate. The product story was, in fact, dominant with almost half of the viewers' responses (48%) noting that as the primary message. Another third of the responses interpreted the message in terms of both stories, while only 10 percent focused primarily or exclusively on the "1984" storyline. It is clear that the negative postmodern imagery did not overwhelm the positive story of a new technology. In fact, we know that is true by tracing the commercial's marketplace impact. The artistry of the sixty-second drama moved over 200,000 of the original viewers to purchase a Macintosh on the following Monday, its first day on the market.

Endnotes

[1] See other science fiction examples such as Samuel Delany's reply in "Stars in My Pocket LIke Grains of Sand (NY, 1984) in which the feminine pronoun is used universally for the psychic subject.

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Legibility Science and the Visual Design of Newspapers

by

Kevin G. Barnhurst

Until the nineteenth century, the knowledge of how type could most effectively convey meaning was based on the traditions of the craft. Through centuries of experiment, practitioners accumulated an understanding of what made type legible. This knowledge was embedded in the practices handed down from master to apprentice for generations. Industrial changes and the demise of the master-apprentice system in the nineteenth century threatened the legacy of the past and debased this traditional typographic wisdom. One aim of the revivalist mentality of the late nineteenth and early twentieth centuries was the restoration of typographic knowledge.

The process took a particular turn at newspapers, where journalists looked to science and scientific inquiry to guide their decisions. Newspaper design was more amenable to scientific control than other publication genres have been, for reasons that derive from the practices and institutions of journalism. Newspaper editors and reporters engage in a search for factual truth that has affinities with the goals of empirical science. The economic pressures of manufacturing a product daily or weekly also encouraged a commitment to science, which was considered more efficient than the slow accretion of traditional knowledge.

The influence of scientific thinking on newspapers took many forms, but one field has been the most influential. Designers have used the science of legibility to push for larger body typography, simplified headlines, and wider, horizontal layout — the principal components of modern newspaper design. This paper outlines the influences of legibility on newspapers and suggests some of the consequences of applying science to the visual design of journalism.

THE RISE OF LEGIBILITY SCIENCE

The science of legibility began by measuring how letters were perceived and comparing how different designs were read. (The former measure is called *legibility*, the latter *readability*, but the two terms are used interchangeably here.) In 1926, R. L. Pyke published a *Report on the Legibility of Print*, which initiated a program of scientific experiments. Pyke began by surveying contradictory results

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from the scattered investigations of printers, advertisers, publishers, psychologists, ophthalmologists, and physiologists of the previous century.

These studies of legibility began in the the 1790s, when the French Imprimerie Nationale asked a panel of expert judges to read type samples at various distances to compare the new modern typeface of Didot with the old style Garamond, which was found to be readable at a greater range of distances. In the 1820s Charles Babbage reported that the aligning figures were more legible for scientific instruments than the numbers with ascenders and descenders. Both of these conclusions were contradicted by later research. Beginning in 1878, Emile Javal's controlled experiments revealed that the reading eye moves in a series of jumps across the page (he called these *saccadic* movements) and that the upper half is more legible than the lower half of letters. From these results, Javal proposed that typefaces be redesigned without descenders.

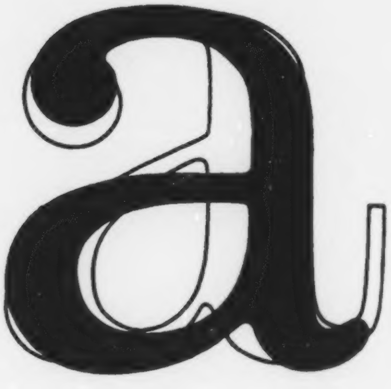
A current reading of Pyke's exhaustive survey of early experiments reveals several patterns: Legibility research may tend to increase during periods of typographic change, when an older style is under assault. Although the goal of the research is usually to find essential truth, the results tend to reflect the customs and practices of the time, familiar to the investigators and study participants. In the French experiment, for example, the experts who found Didot less readable were typographers trained to use Garamond. Legibility study grew over the course of the nineteenth and twentieth centuries, to match the frenzied pace of stylistic change, which was encouraged by changes in technology and industry.

Another pattern apparent in Pyke's report is that early results often get contradicted by later studies, not only as measurements become more sophisticated but also as customs change. Only in the realm of physiological measurements, such as saccadic movements, do concrete observations remain relatively unchanged, but these are without many practical uses in typographic design or selection. For example, no one has taken seriously Javal's proposals to shear off the bottoms of letters.

From his own experiments, Pyke found that only extremely large differences in type produced any differences in legibility. He concluded that readers find most legible whatever type they are accustomed to and that the measurement of "objective legibility must be almost impossible" (Pyke 60). Despite the difficulty, he combed his own and others' research to find this universal standard: the ideal letters for reading body text should be fairly simple, broad, and thick, without extreme contrast. His description seems to suggest that the average, middling, and least distinctive faces are the most legible.

The typographer Ben Sherbow at the *New York Tribune*, John E. Allen, editor of the *Linotype News*, and their followers in American journalism responded enthusiastically to the new science of legibility, which inspired at least a dozen typefaces specifically created for newspapers (Spencer). What the so-called legibility types designed by twentieth-century type founders have in common is the fairly broad, thick letters and unexaggerated contrast recommended by Pyke. The Mergenthaler Linotype Co. introduced the first of the group, Ionic, in 1926, based on an Egyptian of the Clarendon design.

Three more faces — Excelsior, Opticon, and Paragon — were released in the 1930s, followed in 1941 by Corona, the body face recently in use at roughly half of all newspapers. Linotype's chief competitor, Intertype, issued Ideal in 1928 (in response to Ionic), followed in 1935 by Regal, the typeface designed for the *Chicago Tribune*, and then by Rex, created for the *Milwaukee Journal* in 1939. A 1957 design, Imperial, was adopted in 1967 by the *New York Times*, and a fifth Intertype "legibility" face, Royal, was introduced in 1960 (to compete with Linotype's Corona). These faces all fall within the later transitional school (Lawson).



One of the "legibility" typefaces, Linotype Excelsior, superimposed on an earlier standard newspaper typeface, Roman No. 2, shown in outline. From Alexander S. Lawson. Anatomy of a Typeface *(Boston: Godine, 1990), 280.*

Throughout the century, Pyke's successors continued to refine the method of measuring legibility (Zachrisson). Their definitions and methods were usually behaviorist and relied on electrical equipment (such as the tachistoscope, an apparatus that measures perception and speed by exposing words for short, precise periods of time), but they disagreed over what to measure. In the thirties and forties, Matthew Luckiesh advocated a method that counted blinking as a sign of reading discomfort. His studies were attacked by fellow scientists such as Donald Patterson and Miles Tinker of the University of Minnesota, who preferred to record reading speed.

Both methods contributed to the emerging profile of the behavior of the average eye. By the 1960s, researchers had measured the average rate of reading (250 to 300 words per minute), the average reading distance (12–14 inches), the average range of focus (4 letters in the central area in sharpest focus, called the *fovea*, and 8–11 in the peripheral zone), and other measures such as the average fixation pause between saccadic movements and the average rate of regressions (jumping back before continuing ahead), as well as the effects of content, light, paper, and typography on these averages.

The legacy of legibility research has been to document several general observations about typography, many of them long understood within the craft: Capital letters and italics are harder to read than plain small letters. Darker or bolder letters are usually easier to read. Tinted backgrounds have a negligible effect on reading. Dark letters on light paper are easier to read than light letters of the same size reversed from a dark background. Extremely long or short lines of type slow reading by requiring more regression movements or fixation pauses. And justified type (aligned on both sides) is no more legible than ragged or unjustified type (summarized by Rehe).

Unlike craft-based knowledge, these research findings too often acquire the status of immutable laws. But they cannot succeed as design caveats for two reasons. First, the results come from controlled environments that have little relation to the real-world practice of reading. By changing the lighting, the position of reading, and the angle of the paper, readers exert as much control over legibility as any factor researchers measure. The studies not only fail to allow for variable reading conditions, they also do not measure the levels of reader motivation. Although few use a magnifying glass, investors, sports fans, bargain hunters, and others equally committed to specific content routinely read type that breaks all putative laws of legibility. Controlled experiments also ignore the social interactions and ordinary distractions that may impinge on the reader's commitment.

Second, the results aspire to essential truths or universal standards for what in fact are mutable, social practices. At best the rules indicate what is common, popular, and familiar at a given moment in the sweep of stylistic change. But the authority of science introduces a rigidity, a resistance to innovation. As a tool for marketing products to specific audiences, legibility rules may contribute to a predictable standardization. Guided by their knowledge of the craft, designers routinely break rules, pushing the limits to establish new styles. The small type, tightly letter spaced on the long, widely spaced lines now in fashion may not have been scientifically legible when first introduced, but it could soon become so.

SOME CONSEQUENCES OF LEGIBILITY RESEARCH

Legibility researchers have often produced specific results showing that one school or face is superior to another. Just as old style was once found to be more readable than modern, both were recently considered more readable than sans serif. These results usually don't hold up as styles change. Some researchers have tried to avoid the uncertainty of shifting styles by searching for firm ground in an optimum set of specifications. For example, Patterson and Tinker said the ideal book should among other things be set in 11-point type. In 1963, Tinker recommended longer lines (that is, wider columns), more leading between lines, and 8- or 9-point type sizes for newspapers.

Even these general ideals show how little legibility science has understood either the measurement of type or the meaning of the typographic craft. The visual sizes of different typefaces can vary greatly for the same point size. A better gauge of type size might be the height of the lowercase letters exclusive of ascenders and descenders, most easily seen in the small *x*. A large x-height makes 9-point Helvetica dramatically larger to the eye than 9-point Garamond, which has a smaller x-height with long ascenders and descenders. Such variance makes size specifications of legibility research only vaguely meaningful. No standard unit of x-height has ever been established, and even if it were, the variable length of ascenders and descenders would render it of little practical value.

Although the specifications of legibility science fall short as a practical guide, the research did document the changes in newspaper text sizes (Tinker). Late nineteenth-century newspapers commonly used 6-point body type. Although the first "legibility" type was nominally 6-1/2 point, the recommendations of research produced an x-height closer to a typical 8-point type, so that fewer letters fit on the line than the half-point change seemed to imply. By the 1930s, 7-point body had become common, and, in part because of legibility science, 8- and 8-1/2-point were standard by the late 1950s. Recently twice as many newspapers were using 9-point as 8-1/2-point type. Because of the size of the x-height, these types continue to appear larger than their nominal sizes might imply.

The consequences of these changes were more than cosmetic; they had profound implications for journalism (Barnhurst 1991). From 1885 to 1985, the number of words that would fit on the typical front page fell from 12,000 to 4400 (Barnhurst and Nerone). The number of pages in the newspaper increased, but so did the amount of space used for pictures, headlines, and everything but body text. It is safe to say that a great deal of what once could fit on the front page had to move inside, ended up unpublished as overset type, or never got reported at all.

The role of legibility research in this process is clear. Researchers tested reading speed to find the optimum typeface, size, line length, and leading. These objective measures generally coincided with the stated preferences of the study participants. All else being equal, they opined, larger sizes and wider columns with more leading make for faster, more comfortable reading. But all else was not and cannot be equal. A spacious, large-type newspaper must exclude something. All readers might want whatever catches their particular interest displayed that way, as long as somebody else's interest gets pushed aside, off the front pages or out of the newspaper entirely.

Reduced coverage on the front page, where it matters, narrows the audience whose particular interests can be covered there and reduces the chances for creating new interests. As newspapers seek to attract more readers, the use of large type becomes a structural barrier to diversity. Although it might be slower to read, a tighter front page can serve a more diverse audience and reward minority cov-erage. As readers find more groups treated prominently, including their own, they might identify more strongly with the newspaper. In other words, a moderate reduction in conventional legibility could in fact increase readership. And even if it failed to do so, the change would signal the newspaper's commitment to a civic, rather than merely commercial, agenda.

POSSIBLE MEANINGS OF CHANGING TYPE SIZES

Larger type not only reduced the coverage on the front page but also tied the newspaper to particular ways of reading and groups of readers. The largest body type, a 12-point size called *primer*, is linked to juvenile readers. Conventional practice since the nineteenth century has connected primer type to school readers and picture books for children, even though research in the 1960s found that the smaller the child the smaller the legible type (Swann). The next largest body type, commonly referred to as "large print," is linked to older readers. Large-print bibles and "senior citizen" printed ephemera have set the conventional significance of these type sizes. Small type, set 8 points or smaller, is linked to assiduous, devoted readers. It is used conventionally in the fine print of contracts and reference works. By shifting from fine print to large print, newspapers abandoned their visual role as a compendium, favoring instead the typographic dress of leisure and retirement. Except in classifieds and in business and sports statistics, the signs of the poring and culling aficionado of news were replaced by the signs of comfort and convenience that signify either the older or the casual, uncommitted reader.

Many other factors came to bear in this process. American publishers for some time have been aware that the U.S. population is aging (Bogart). Older readers take more time to read and are among the most loyal of newspaper subscribers. Enlarging the type seemed to serve an important, primary audience for the medium. Publishers have also recognized that larger type can help the bottom line. If fewer words can fit on a page, then fewer need be researched, written, typeset, and printed. Profit, however, was probably of secondary concern. Enlarging the type size seemed to provide a way of serving readers while simultaneously saving money. Everyone appeared to benefit. But publishers and legibility researchers made a fundamental miscalculation.

Adopting the visual signs of leisure activity and older readers aligned the medium with a narrowing audience. As leisure time declines, the newspaper-as-leisure must compete for readers' free time. A quick and easy design requires relaxed contents, not the hard stuff of documenting community life and assisting with the chores of adulthood and the duties of citizenship. Leisurely content in turn makes the newspaper optional, just another recreational outlet among many. The aging population might seem to promise some respite, but only temporarily. Newspapers cannot survive without a constant infusion of young readers, who are the least likely to adopt a form clearly marked with the signs of advancing age (Barnhurst and Wartella).

CONCLUSION

These consequences for the content of the newspaper and the meaning of its typographic form are only partly due to legibility science. The researchers were also participating in the style of their times. Pyke, who lived in an era that could not accept sans-serif type in text, disregarded his own finding that plain typefaces were more legible. When Tinker, who worked in a period enamored of all things large and spacious, found that 7-point type was just as legible as 8, he still called for larger sizes. Recent research on justified columns recommended setting type ragged, despite its own findings that neither justified nor ragged type had significantly better legibility. These recommendations spring not strictly from the data but in no small measure from the prevailing visual style. A concern for content and for consequences might have led newspapers in quite a different direction, perhaps to smaller, sans-serif body type.

Science influenced the changes in newspapers in many other ways during the twentieth century shift to modernism. In typography, the field of study called congeniality research attempted to find an empirical guide to choosing typefaces that conveyed certain emotional connotations (Ovink). During the sixties, the science of proxemics seemed to provide evidence that a more-open, spacious layout was more democratic (Hall). Other ideas, such as the principles of design commonly included in newspaper design textbooks, acquired a quasi-scientific status or claimed the status as universal laws by tracing a genealogy back to the Greek philosophers (Barnhurst, forthcoming). Designers succeeded in harnessing science to give authority to visual decisions, and newspapers have, for the most part, adopted modern design. The larger typography, pictures, and simplified layouts have reduced the number of stories and items on the page and introduced more space. On the whole, newspapers can be said to have become more legible and more aesthetically designed because of these changes.

But in all of these cases, the application of science to newspaper design has had unintended consequences. Minorities and other cultural groups now seek more coverage, but less can be covered on a front page that displays fewer, larger (if more beautiful and more legible) items. Minorities have difficulty winning a larger share of what has been a shrinking pie.

Legibility along with other areas of scientific investigation and so-called philosophical principles are widely used in the field of visual literacy. They provide valuable guidance for beginners but also require some caution. At times, compromising legibility and beauty may serve a greater number of readers and allow more diversity of content.

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Multimedia Science Education, Visual Literacy, and the Structure of Intellect

by
Andrew J. Peterson

The development of multimedia technology has many implications for instructional design, performance assessment and the patterns of education in America. With interactive, visual archives, the teacher or student can demonstrate competence and become expert in a wide range of disciplines. Any one study, for example, history, can easily draw from other disciplines such as music, art and literature. Another computer-based revolution with many personal and cultural implications is on the horizon. The journey promises to be an interesting exploration of meaningful discovery.

The Project

This paper presents a case study of the use of educational multimedia. In the Spring of 1992 one of the authors, a high school student, produced an interactive multimedia project for the California State History Fair. A Columbus theme was perfect for the application of multimedia. The great explorer has been memorialized in picture and song for generations of Western Civilization (Grant, 1992).

For the first time, the state History Fair competition included a multimedia division. Although the use of multimedia in contemporary educational technology usually implies an interactive design, the competition was limited to a 10-minute slide show. This fact was discovered after much time was spent on an interactive design. In order to preserve the interactive component and meet the Fair's requirements a special button was put on the interface for the linear presentation. The Santa Fe Columbus project did win at the San Diego county level, but it was not selected as a top performer at the state level. With the foregoing as context for the project, the tools and design considerations will be described.

The Tools

Hardware

This Columbus project was developed on the Macintosh platform. A Quadra 700 was the computer employed. Including high-quality, color pictures with a decent amount of resolution requires a great amount of computing power

(RAM) and storage. The program, which totalled almost 112 mb, was stored on a Pinnacle Micro REO-130 Optical Disk (128 mb).

The audio and visual material was prepared by a La Cie 24-bit scanner for the pictures and a Farallon MacRecorder for the music and narration. At the fair a Proxima Ovation color LCD panel was used for the presentation.

Software

In order to integrate all the sights and sounds sophisticated software was required. MacroMind Director 3.0 was the main application software used to build and support the program. Pictures were altered with Adobe Photoshop 2.0. and sound was edited with the Farallon Sound Edit.

The Development

Background of the Artist / Scholar

The 17-year-old artist/scholar had a good background in computers from an early age. As the personal computer revolution moved through the 80's, he stayed with the current hardware and software as it advanced in visual dimensions as well as speed. His first electronically published work was in Verbum Interactive at the age of 14. Additionally, an internship was obtained through the work on VI. During the summer between sophomore and junior years, he worked at GTE/Imagi-Trek, an R & D shop for a major phone company and the group that mastered VI. Over the summer of 1992 the young artist completed a stint at General Magic, another hi-tech shop. The statement of his goal was as follows:

> When I set out to create an interactive multimedia presentation, I set myself one goal: To prove to everyone that it doesn't take a large company with a budget of millions to create a multimedia presentation. A single Mac user can create his own interactive presentation, with a little creativity and hard work. When I started, my imagination was the limit. I created an environment in my head, where all of the knowledge around a single subject could be presented in a user-friendly way.

Step by Step

The product was completed according to the following phases:

1. Research
2. Design
3. Programming
4. Illustration
5. "Tweaking"

The development began with an immersion into the content of the topic. Library work, reading, discussing and reflecting provided the source material. Visual works were selected and scanned. It was this familiarity with the content which most shaped the later design choices. While experience with the computer interface was necessary, it was the structure of the content that motivated and honed the program.

Given the content and its form, the next step was to design the user interface and the script. The modes and context for the navigation were devised. A glance at the content, flashes of insight, more research, plus trial and error characterized the journey. General gestalten were sought and grammatical details were fine-tuned. The composer remarks:

> When it comes to multimedia, I think the best process for learning new things is by experimentation. I tested out a lot of new ideas when I created my Columbus presentation. QuickTime was a relatively new program then, but I practiced and tested it out in the course of my work. You always need to try to see if things work. I started with a plan, and then got rid of all the ideas that just didn't work.

Programming in multimedia involves pictures and music as well as text. Links between graphics, pictures, human voice and sounds were made behind the scenes, yet accessible to the user. The author worked long and hard to get his narration and its access by the user just right:

> If you create an environment where the user controls all of the knowledge by letting them do their own navigating, then you've succeeded in creating an interactive presentation.

Once basic programming was written and primary media sources were in place, a good deal of illustration was required to complete a user interface "keeping what really looked good and what was easy to use". For instance, the Columbus Timeline was drawn so the user could enjoy viewing and selecting from a series of relevant dates. Further illustration was done with music. It was interesting to experience the drama from the addition of *Carmina Burana* to the opening paintings. The producer comments in this regard:

> I think it can be really exciting to bring together movies and sounds, along with pictures and words. The separate sections of a multimedia presentation when brought together can create a really exciting presentation.

Last came the "finishing touches". Again, more trial-and-error and double checking. Occasionally a new primary source would be found for incorporation. The final product will always be WIP ("work in progress"). According to our young composer the journey was well worthwhile:

> What I learned most about multimedia, is perhaps the amount of work that goes into it. Always paying attention to all of the tiny details is the major work of doing an interface. But in the end, I think nothing is greater than seeing faces light up with excitement, especially when the gift you are giving them is knowledge.

Graphical User Interface (GUI)

The Macintosh Way

In the late 70's, the microprocessor made the personal computer a technical possibility. But at the time there was great concern that the digital computer would decrease rather than increase personal freedom. The Orwellian vision was a common dread. However, the technical possibility was made real by breaking the operating system codes with a visual metaphor. At Apple Computer Company the novel idea was proposed that one should work with a computer in the same way other daily office tasks are accomplished. Thus, the Lisa R & D program at Apple engineered a user interface based on the visual images of the desktop metaphor. The icons composed the first commercially available Graphic User Interface (GUI). The huge success of *Windows* finally proves Apple's point--even to the PC world.

Computers and Big Brother

In *Microcosm: The Quantum Revolution in Economics and Technology* (1989) George Gilder has rightly pointed out that the Information Revolution has brought a qualitative difference to our economy and way of life. While the issues of faith and family have not changed, the material aspects of our life must be seen in a new light since the advent of the digital computer. The Industrial Age had its own distinctive characteristics from previous eras. Although vision and insight were crucial for those enterprises, so much of the daily means to accomplishing projects required raw materials and the brute strength of men and women. All capital was material, it could be touched and seen. But the Information age is different:

> Today, the ascendant nations and corporations are masters not of land and material resources but of ideas and technologies. Japan and other barren Asian islands have become the world's fastest-growing economies. Electronics is the world's fastest-growing major industry. Computer software, a pure product of mind, is the chief source of added value in world commerce. The global network of telecommunications carries more valuable goods than all the world's supertankers. Today, wealth comes not to the rulers of slave labor but to the liberators of human creativity, not to the conquerors of land but to the emancipators of mind. (Gilder, p. 18)

In the 50's computers such as ENIAC at the University of Pennsylvania filled very large rooms with their bulk of vacuum tubes and heavy electrical wiring. International Business Machines applied its expertise in building and marketing reliable, if unimaginative, office equipment to the corporate and government bureaucracies. Computerization meant standardization and control. Extrapolating these attributes to the political order was worrisome indeed. Many predicted that centralized, collectivist governments would spring up with this new technology as an efficient, heartless means to subjugate the masses. Indeed, Left-oriented politicians have tried to extend the reach of the state into private life through computerization and the increasingly detailed questionnaires of the Internal Revenue Service, Social Security, and the Census Bureau.

Then came the personal computer revolution. Once the engineers made the machine affordable, the computer became personal in the sense of unique expression of one's interests and abilities as well as an appliance that could be used at home. At first, the IBM computer community actually ridiculed the very idea of computers for the individual which were user-friendly. People in large businesses had little reason to want a computer at home. Yet this was the vision of a group of young people in the Bay Area called Apple Computer.

However, would not this be the last place to expect interest in computers? The mix of Xerox, Stanford and Berkeley was a heady brew. Apple set out to make a computer "for the rest of us"--those who were neither engineer nor bureaucrat. Even Hubert Dreyfus (1972), University of California's philosophical critic of the computer mind-set, had always advocated using artificial intelligence if it was done with the right perspective and for the right reasons.

As Apple Computer and others built personal computers, the idea caught on fast. Apple marketed their machine as a "mental bicycle" allowing individual users to go places they had never visited. The Apple interface was made increasingly more "user-friendly", culminating with the Lisa/Macintosh system. It was a self-conscious choice to emulate the way the average person works. This route was taken in the face of great opposition. The goal was to allow the occasional user to be able to calculate, list and print without a long series of arcane commands that were typical of the IBM-style of computer.

Being a new technology, unhampered by government regulation and meeting an apparent need, the approach thrived in the free market. "Power to the people" became a reality rather than a cynical slogan to manipulate Chinese and American intellectuals. Computers were now used by pastors to record their sermons, small businesses to keep their inventories, grass-roots political groups to raise money with special mailing lists, etc. This was a new medium *not* controlled by network television, the United States Post Office or the Ivy League universities. Today millions of Americans own computers that can provide calculations, databases, spreadsheets, word processing, and desktop publishing. Only a short time ago these functions were business tools available only to a wealthy few. In fact, the lead in technology and sheer number of personal computers and fax machines was a great problem for world communism. Thus, the social impact of the computer turned out to be productive rather than oppressive.

The MultiMedia Way

Once again a technological breakthrough has made personalization of high-level work possible for the individual. Add visual and auditory data to print and the result is a revolution with all the basic myths and opportunities (Hawkins, 1992). Multimedia is now possible on the desktop. A Columbus production can be done with a million dollar budget or no budget.

As in 1978 another digital revolution is occurring for the individual—personal multimedia production. The interface must again be intuitive with lots of visual cues. But even more so with visual material as part of the content, those who do not know "the code" are invited to participate. Both interface and content contain visual cues for understanding. To use a theological analogy, the transition from general revelation of visual images to specific verbal information is quick and obvious, given the right content and the right design. Eventually users can learn the code, as they need it, and more. This new Columbian journey is just in the planning stage of a great exploration in knowledge and communication.

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Science Learning and Interactive Videodisc Technology

by
Janet L. Bohren

A pilot study with seventeen middle school science teachers at fifteen schools was conducted to determine how to use interactive videodisc technology to develop student ability to use visual skills in processing science information and thus improve science achievement. This paper describes the first year's progress in identifying how visual images seemed to effect student learning and the analysis of a survey of student attitudes toward the use of images to learn science.

Interactive videodisc images (still and motion) were used by the teachers in this project to illustrate science information presented to students in their textbooks and during lecture/discussions of science material (level 1 use). Two teachers who had access to a Macintosh computer lab had their students build interactive presentations in which they mixed text, graphics, sound and videodisc images to build HyperCard projects on science topics being studied in the classroom (level 3 use).

How Pictures Enhance Text

Holliday (1992) stated "Science learning materials rely heavily on visuals to communicate important information to students trying to understand complicated ideas and solve difficult problems. Thus it's important for teachers to select materials--including but not limited to textbooks--that contain effective visuals and, in turn, to use them effectively" (p.5). A variety of research articles and reviews on the relationship between text, illustrations, and learning published over the past fifteen years have highlighted a long succession of studies that attempted to understand how students use external images on the page and internal images in their minds to learn.

A review of research studies published in the seventies by Levin and Lesgold (1978) found "abundant empirical evidence to document the positive value of pictures" (p.233) for children when fictional narratives are presented orally with pictures that overlap the story content. A review of 55 experiments comparing learning from text or text plus pictures by Levie and Lentz (1982) found that illustration facilitated learning of information in written text in 85% of the cases. Levin and Lesgold (1978) believed pictures induced deeper levels of processing.

Anglin (1987) reported that Levin (1981) listed seven functions that prose-relevant pictures may serve: decoration, remuneration, motivation, reiteration, representation, organization, interpretation, and transformation. Levie and Lentz (1982) suggested that pictures, charts, diagrams, etc. encourage "'visual thinking' and can carry some kinds of information more effectively/efficiently than linguistic symbol systems" (p.226). The way such visual thinking with external images is more efficient was analyzed by Larkin and Simon (1978), who concluded that a diagram's utility "arises from perceptual enhancement" (p.95), i.e. the spatial arrangement of information provides a large saving in the mind's computational processes to use the information in the diagram. They speculated that internal images play a similar role to external images in problem solving. Such work provides a strong reason to enhance the use of images by science students in learning.

Conflicting evidence is found in the literature regarding retention of information learned in the presence of images. Recent work both confirms and rejects a trend reported by Levie and Lentz in 1982, that "the superiority of the illustrated text version was more pronounced (a) in delayed recall than in immediate recall.." (p.225). For example, Anglin (1987) and Anglin and Stevens (1987) did studies that indicated that college students learned more (as indicated by immediate recall tests) from an illustrated prose passage than from a prose passage alone. However, the effect was not significant on delayed recall after 28 days in the 1987 Anglin and Steven study, but was significant after 55 days in the 1987 Anglin study. Mayer's (1989a, 1989b) studies indicated that science information in diagrams and illustrations enhanced conceptual retention and problem solving, but not verbatim retention.

The relationship between verbal narrative and visuals has also been studied. Vasu and Howe (1989) found 2nd and 4th graders could both draw and orally describe Kiwi fruit significantly better when information was presented both visually and verbally as contrasted with visual only presentation. After two weeks the visual/verbal treatment group was still significantly better than the visual only group on oral description scores but not significantly better on drawing scores. Mayer and Anderson (1992) have extended Mayer's work on explanative text and illustrations to multimedia in their study of adult learning from computer graphic presentations. They concluded that the most effective method of instructional presentation was to run narration and animation at the same time.

Of critical importance to understanding the role of visual images in instruction is an understanding of skills students have to "read" images. In the above studies no efforts were reported in which subjects were taught how to use or "read" images. A study from England by Constable, Campbell, and Brown (1988) emphasized the importance of this point. They showed that eleven-year-old students were not able to interpret correctly the cut edges in various sectional drawings typically associated with their biology textbooks, most probably because students did not seem to be aware of many of the pictorial conventions used in biology textbook diagrams. They concluded that teachers need to teach students about pictorial conventions used in illustrations in order for students to be able to make use of these images in their learning.

The understanding and enhancement of student use of external images (both still and motion video) to learn science is critical to the appropriate use of multimedia technologies for instruction in the classroom. Scientists have often described their thinking in terms of the use of visual imagery, which is later expressed verbally and/or mathematically. Today scientists are using an ever increasing array of high-tech imaging tools to explore, model, and synthesize their work (DiBiase (1992), Friedhoff (1989), Autodesk, Inc. (1992))· It thus becomes ever more important that science students develop visual skills for learning science. The above literature studies indicated that students need to be more consciously taught the power of using images for learning.

Study 1: Student perceptions of how videodisc images helped them learn science

Method:

In our pilot work we wanted to better understand what kind of information students were learning when science images were presented via the videodisc player and monitor. Thus, students were asked to answer a series of written questions after completing a unit in which the teacher used the videodisc as part of the instructional strategy. One set of data collected by a teacher from five different 7th grade classes provided a particularly rich set of data and is reported here. Data from the other teachers tended to confirm what is reported below.

The teacher used the videodiscs[1] to present images on the formation of the universe and the planets. Images used were both still and video and generally supplemented her board diagrams and discussions of the textbook. She allowed her students to take turns narrating a short 1-2 minute segment of video on nebular formation to review for a test. After using the videodiscs, students wrote answers to the following questions: 1) What pictures do you most remember seeing on the videodisc player? 2) Did the videodisc pictures help you learn science? How? 3) Did the videodisc pictures help you understand your textbook and teacher better? How? 4) Can you learn what you need to know for tests from the videodisc? Please explain. 5) What did you like about using the videodisc player? 6) What didn't you like about using the videodisc player? The teacher was interviewed about her experience using videodisc images to enhance her teaching and about her observations of how it effected her students' learning and test achievement.

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[1] Windows on Science: Earth Science volumes I & II, The Living Textbook: Astronomy and the Sun. Optical Data Corporation: Warren, N.J.

Results

Analysis of 56 sets of student answers revealed four basic patterns of responses. Students spoke of how the videodisc images effected their use of **words,** their understanding of science **processes and scale,** how well they **liked science**, and how they **learned science with pictures**.

Part of students' science achievement is measured by the **science vocabulary** they learn. The teacher was surprised at the number and variety of vocabulary words the students used in their descriptions of what they learned, considering the general nature of the questions. She indicated that the answers (most covered 1/2 - 1 sheet of typical notebook paper) were much longer than she had expected. Almost every student paper contained 5 to 10 specific terms such as sun and sunspot, planets (including their names), space terms, and terms about dinosaurs and food chains. Statements such as the following were typical of student responses with regard to the videodisc and word use:

"I can see it, then read it..."
"it adds more information about the lessons and more wording."
"it brought my from-board notes to life.."
"it helps us with our words"

Students must learn many different **processes and the scale of objects** in science. One important process taught in the astronomy unit is the nebular theory of how the universe formed. The teacher used a short video segment from the videodisc to teach this theory. Many students mentioned how the video helped them understand this process. Some made comments on the relative sizes of the planets and sun and a number directly stated that they liked the realism of the images. Some typical comments were:

"What I learned is the earth rotates.."
"I learned that the sun is bigger than all of the planets.."
"I learned that the sun is not the biggest star. That the sun is big enoth for the 7 earths to fit in it."
"It showed us real photos of the things we were studying."
"I remember most about the sun diagram."

Dinosaurs are a favorite topic for students, so on one day the teacher showed a three minute dinosaur video, although the topic was not part of the unit in astronomy they were studying. Thirty of the fifty-six students mentioned the dinosaur segment. The teacher was amazed at how much the students wrote on this segment, as they had not discussed it in class nor had they read about this topic in their texts. Some typical comments that illustrated student attention to the **science process of extinction** depicted by the dinosaur video were:

"The most I remember is how the dinosaurs got extinct."
"I learned how the planets formed and the dinasaurs got extinct."

Almost all students responded that they would **like to use** the videodisc everyday. A few noted that it was very boring without sound. The teacher also noted that students wanted motion and sound and were not very interested in the still images[2]. Some typical student comments relating to why they liked using videodisc images to learn science were:

"The laser disc added a lot of things that I needed to know in science..."
"It added excitement for me and enthusiasm."
"It was a fun activity."
"It helped us learn about things better ..than in a book."
"It taught me more about science than what the book taught us."
"It taught me things I knew nothing about.."

A few of the students directly said that using the videodisc **images** was the way they liked to learn. For example:

"the pictures stuck in my mind."
"gave me clearer idea..."
"learn better than book..."
"learn without people talking..."
"shows us a better vivid picture of what (teacher) was trying to explain.."
"it tells you quicker than you can read"

Study 2: Middle School Science and Instructional Technology Opinion Scale[3]

Method

A 29 item survey was given to 395 students in the spring to ascertain their opinions about the use of drawings, videotapes and videodiscs, books, labs, and HyperCard for learning science. A scale of 1-6 was used to rate the answers: 1 = don't know, 2=strongly disagree, 3=disagree, 4=sometimes, 5=agree, and 6=strongly agree. From a variety of written student comments in our pilot work, it appeared that even if students liked to learn with images, they were not convinced this was what would enable them to do well on their tests.

Results

Five questions asked students about their perception of **the relationship between images and test achievement.** Table 1 displays the questions with means, standard deviations and percentage of students who selected each choice. On questions 1 and 2, most students took the middle road and said that "sometimes" they liked to use drawings on the test, resulting in means of 3.96 and 4.26. Means of 2.7 and 2.5 on the questions 4 and 5, which referred to the utility of videodisc images to help on tests, indicated that most students did not perceive the material displayed to them to have direct bearing on what they were studying, although the teachers all used images directly related to their units of study. Of most interest, however, was an analysis of the percentages of the Likert scale for each question. Overall, this analysis showed that about 10% of the students **strongly agreed** with statements supporting the use of visual skills to learn science.

On the first three questions about drawing in Table 1, 34-45% of the students answered "sometimes." Twelve to thirteen percent of the students "strongly agreed" that they liked questions with drawings or that asked them to produce drawings. Data indicating "strong agreement" by 15%, "agree" by 25% and "sometimes" by 40% of the students to another survey question which stated "I like to make science drawings in class" help substantiate the percentages reported for questions 1 & 2. Seventeen percent of the students also "strongly agreed" that they liked to make a picture in their heads to help them remember for tests.

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[2] Still images on a videodisc do not have sound.

[3] Some of the items were based on items from the BSCS "Middle School Science and Technology Attitude Scale," BSCS March 1991.

Data in Table 1 for questions 4 and 5 indicate that about 50% of the students "don't know" if the videodisc images would help them on the test. However, 5-7% "strongly agreed" that these images would help them and 21% answered these two questions with "sometimes." The data on this question were very similar to data on another survey question stating "using the videodisc helps me understand what I am supposed to learn in my science class," where 53% answered "don't know," 2% "strongly disagree", 4% "disagree", 15% "sometimes," 14% "agree" and 10% "strongly agree."

A series of questions at the end of the survey asked the students to respond to six different statements beginning **"I learn science best by ....".** Table 2 gives the results. Because students were not asked to rank order these questions, many answered sometimes for more than one. However, 11-20% strongly agreed with each statement. The only question on which there was not a bell-shaped distribution of answers was #4. On this question there was an ever larger number of answers as one moved towards the strongly agree end of the scale. One third of the students "strongly agreed" that they learned science best by doing it; 91% ranked this question either "sometimes", "agree", or "strongly agree."

In response to the statement that "I learn science best by seeing videotapes or the videodisc movies," 43% said "sometimes", 25% "agree", and 13% "strongly agree." On the related survey question, "a good way for me to learn science is to watch a video or videodisc movie," 29% answered "sometimes", 26% "agree", and 20% "strongly agree."

Discussion:

The written data in answer to the general questions about videodisc use indicated that stimulating verbal achievement with visual images under the control of teacher or students is a successful way to improve science learning. Research is being conducted presently on how to use multimedia technology to strengthen the visual/verbal learning bond (see figure 1).

Survey results indicated that 11% to 17% of the students **strongly agreed** that learning science using various types of visual images was their preferred mode. This is

Table 1 Mean Scores and Percents for Image use / Test Achievement Questions

Question	Mean, SD & % frequency of answers
1) On tests I prefer to answer questions that ask me to draw something and label it.	M= 3.96, SD = 1.12 sa = 12% a = 17% s = 39% d = 19% sd = 13%
2) On tests I like to answer questions that have drawings in them.	M=4.26, SD = 1.02 sa = 13% a = 25% s = 45% d = 11% sd = 6%
3) I like to make a picture in my head about what I learn in science class to help me remember for the tests.	M= 4.46 , SD = 1.02 sa = 17% a = 33% s = 34% d = 12% sd = 4%
4) Learning science with movies on the videodisc helps me to do better on tests.	M= 2.76, SD = 1.62 dk = 52% (don't know) sa = 5% a = 12% s = 21% d = 6% sd = 4%
5) Learning science with the still pictures from the videodisc helps me do better on tests.	M = 2.52, SD =1.75 dk = 46% (don't know) sa = 7% a = 15% s = 21% d = 8% sd = 3%

Table 2 Mean Scores and Percents for "I learn science best by..." questions

1) I learn science best by looking at the pictures and charts in my science textbook.	M=4.22, SD=1.00 sa = 11% a = 23% s = 46% d = 14% sd = 6%
2) I learn science best by reading the textbook.	M=4.01, SD=1.15 sa = 12% a = 19% s = 37% d = 21% sd = 11%
3) I learn science best from listening to the teacher explain science.	M=4.34, SD=1.18 sa = 18% a = 29% s = 33% d = 10% sd = 10%
4) I learn science best by doing hands-on science lab activities.	M=4.86, SD =1.05 sa = 34% a = 31% s = 26 % d = 6% sd = 3%
5) I learn science best by seeing videotapes or the videodisc movies.	M =4.22, SD=1.12 sa = 13% a = 25% s = 43% d = 9% sd = 10%
6) I learn science best by writing notes and answers to questions in the book.	M=4.24, SD=1.20 sa = 18% a = 22% s = 37% d = 12% sd = 11%

sa=strongly agree, a=agree, s=sometimes, d=disagree, sd=strongly disagree evidence for the presence of a consistent percentage of visual learners in our science classrooms that we need to reach more directly with visual instruction as the springboard for achievement.

Sixty to eighty percent of the students indicated a point on the continuum of "sometimes" to "strongly agree", that the use of visual images helped them learn. With this large a group of students interested in and confident in the use of visual skills to learn science, science teachers should be able to improve science achievement with a more direct use of images. Videodiscs, at both level 1 and level 3 use, provide far more powerful access to images for learning than videotapes or slides, because of the control this technology affords both teachers and students.

All teachers in this research project reported increased attention and better behavior on the part of their students when videodisc technology was being used. Part of this was due to the newness of the technology, but another part was due to the increased control over image use. This was particularly apparent in the classroom using level 3 technology, where students produced their own science HyperCard stacks, illustrated with videodisc images. There the teachers reported a noticeable increase in self-directed learning and motivation for learning science.

Based on the above research, a model (figure 1) has been developed to guide the instructional use of images in the classroom.

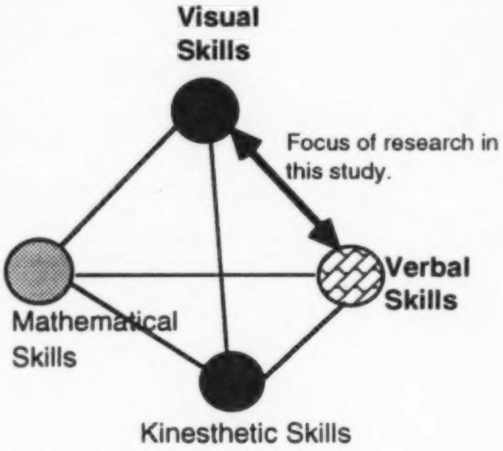

Figure 1: The Pyramid of Skills Supporting Science Achievement

The above skills are all key to the learning of science. Each set of skills is enhanced by the other and *used in balance* allow the student to construct a core of knowledge connected by multiple paths to information. For example, the development of kinesthetic skills through the doing of science is important to understanding the theory of science expressed verbally, mathematically, and visually. Visual skills greatly enhance the mastery and use of mathematical skills in problem solving, etc. Thus, instruction can be designed to focus on the different connections and planes of this pyramid, with the goal of enabling the student to develop a well-balanced knowledge core of learning skills which will lead to science achievement.

In this research we have begun to look at the relationship between learning visually and verbally, as indicated by the heavier line in figure 1. In some instances, student achievement was improved by having the student move from the visual image to the verbal description, instead of the other way around. The theoretical work of Levin (1981), Mayer (1992) and others provides a base in which to ground future research. This research will be conducted along each of the lines and across the planes of the above model, to enable us to better use the multimedia technology that is offering teachers and students new avenues for learning and doing science.

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Dr. Artist

by
Thomas R. Lightfoot

"We used to be much more confident about drawing distinctions between the things we could measure in the world 'out there' and the ideas we concocted about them, or the representations we made of them" (Vanadoe, 1992).

The change Kirk Vanadoe refers to confirms the interesting proposition that the world is in the midst of a major paradigm shift. The scientific paradigm of dominion over nature is coming to an end with the acceptance of the arts and other "soft, warm, wet" (Witt-Miller, 1991) technologies as equal partners in our effort to live in harmony with the universe.

Enthusiasts of the computer age often dismiss the fear and rejection of modern hi-tech science, advanced medicine, and contemporary society by some people as the mere foolishness of Luddites who are afraid of change or anything new. A serious, longer and deeper look reveals that people are very likely reacting to the disregard for their very real and important subjective inner selves in the modern world's overwhelming emphasis on the external objective realities of science and technology.

A brief and very selective overview of people's attempts to understand the world and their place in it will give the perspective needed to see how this shift has come about.

The relationship to existence of our ancestors was, essentially, governed by a behavioral model. Beneficial behavior was learned through reinforcement. Chance encounters, when repeated, yielded the same results time after time. When the individual faced similar circumstances, responses became habitual. This early relationship with the world was shared by most living things. Real thought or consciousness was not involved at this point in evolution (Jaynes, 1990). Eventually, however, this did lead to an abstract understanding of causality. Not only did things happen repetitively and sequentially but, in fact, one event made another happen. This led to the even more abstract extension of this principle to understanding and even trying to control events in the world.

Cooperation between people evolved as a very successful means of survival with people divided up responsibilities. The shaman must have come out of this division of labor along with the understanding of cause and effect relationships. As opposed to the nurturing mother and hunter-warrior who both operated more from the instinctual, behavioral level, some people must have had a greater sensitivity to these abstract relationships.

These early abstract thinkers knew how things worked. These individuals were in tune with the subtler connections between events, sensing which things led to others. Thunder and lightning led to rain. Certain plants helped wounds heal. Painting an animal on the wall of a cave and spearing it led to better hunts.

Some of this knowledge could be relied on. It could be repeated when necessary with predictable results. Some, however, was not as certain. This was the beginning of the separation between science and art. Science was practical and could be counted on while art had problems with repeatability. Art depended too much on personal involvement. It did continue to satisfy a perceived valuable role in people's lives. It had a connection with all that science could not explain.

There were many things beyond the practical grasp of science. People wondered where everything came from and why they were here. So, art took up the search for the internal realities of the emotions, the powerful feelings that made people act. Since art usually had little impact on everyday survival, science became the primary emphasis in moving forward toward easier lives.

The practical predictability of science was its power. Simple, linear causation, one thing leading directly to the next, was the cornerstone of its predictability.

Language developed in the same manner. Language narrated this movement from one thing to the next. Language allowed the understanding of causation, assuming *understanding* to be relating something new to something familiar as Julian Jaynes describes it (Jaynes, 1990). Language became the means to make the new and strange familiar.

Language translated simple causative events into familiar metaphors by labeling things and events. "This causes that" is the result of abstracting many similar events, reducing them to the common elements within them. Commonality is nothing more than sensing the familiarity within significant parts of events. Language is employed to label these isolated common characteristics. This ability to categorize, label, and communicate a category of experience became the essence of science.

The experiences that resulted in art did not conform to this linear abstraction. Events were experienced as a whole. Many associations between things had no apparent sequential or causative relationship. Metaphoric, linear language equivalents could not be used in relation to these events. Since the experiences that art was expressing did not have causal relationships the only way to communicate them was through metaphoric equivalents that did not have linear, causal components either. Painting and sculpture equated one experience with another without abstraction, without reduction, without generalization, therefore, without familiarization or understanding and without the ability to communicate reliably. This eventually rendered it practically useless for everyday survival needs.

Science took the lead as the most important human activity in solving problems and putting forth the promise of understanding and explaining existence itself. The repeatability of the results of scientific enquiry made it seem like it was describing some objective reality, that the model of the world which it created was an immutable fact or at least led in that direction. All that had to be done was to get some of the bugs out.

Model after model was imposed on the world, always with another bug to be worked out. First one anomaly then another didn't fit the model. More inclusive models were devised and more anomalies showed up. The quest for an all-inclusive model of the universe proved to be illusive and remains so to this day. In fact, it seems that the quest itself has reached some insurmountable roadblocks. The closer scientists think they are getting to an all inclusive theory the hazier objective reality becomes. The distinctions between objective reality and the subjective observer disappear at the heart of the matter.

Kirk Vanadoe's statement at the beginning of this paper has actually been true for a long time. Once Albert Einstein in 1905 stated that light could exist as a particle as well as a wave, the idea of objective reality became very problematic. How could one entity, light, have two distinct and mutually exclusive states of being. This paradox led to a series of speculations about our inability, if not the impossibility, of defining objective reality.

Niels Bohr's theory of complimentarity confirmed and brought general acceptance to Einstein's paradox in scientific circles. Werner Heisenberg's uncertainty principle extended this concept, recognizing that the outer, observed world is integrally connected with the subjective observer. John Wheeler, a student of Bohr, suggests an even more general perspective with the mind and the universe being complimentary parts of a binary system where one part makes no sense without the other (Shlain, 1991).

The general population has hardly been aware of the implications of this paradigm shift until very recently. The only awareness by the average person has been that science and its handmaiden, technology, cannot solve all of the world's problems. People now realize that science and technology cause as many problems as they solve. The superior position of science, logic, and rationality is now in question. These cannot give a definitive answer to what the universe is like any more than art can. What people believe affects what is. How people imagine the world makes it so. People create their own reality as much as it defines them.

Evidence of the effects of such a fundamental change in world view (really, a fundamental change in the total understanding of the universe and the way people interact with it) is emerging, as one would expect from such a paradigm shift, from all levels and areas of society.

The universality of this change manifests itself in very divergent areas, making it very difficult to see the common thread that connects them all. By bringing the significant, and, seemingly unrelated, recent events together under the lens of this hypothesis their interrelationship can be seen.

One such significant event, the rise of religious fundamentalism, if viewed in this way, is happening because people are feeling the breakdown of the rational grip that science has had over people. The chink in the armor of science, the admission of subjectivity, opens a hole for all areas that depend on subjectivity to penetrate.

Religion's specialty has been to codify subjective experience. Some people are now beginning to think that if science doesn't have all the answers, maybe religion does. Like a pendulum reaching the end of its arc the inevitable swing to the other extreme is already anticipated, religion being one subjective opposite of objective science.

The successes of science and its apparent objectivity fueled the previous paradigm shift penetrating all levels of society. Religious, moral domination gave way to scientific, legal domination. Religion gave in to government, inspiration to pragmatism, morality to amorality.

The promise of science in these areas, however, was not fulfilled. Social ills could not be understood or fixed by science. The amoral atom does not have an equivalent in society. People do not interact by the strict rules of physics. Their interactions are, more often than not, messy and governed more by "soft, warm, wet" (Witt-Miller, 1991) ideas than by hard and cold facts. Many people, sensing this failure and wanting to fill the gap, are returning to the older religious answers.

The kind of overall changes suggested by this thesis would inevitably mean that drastic changes would occur at the level of basic social organization. Such a change has taken place with the fall of communism Though western scientists would probably not want to take credit for it, communism was the direct result of applying scientific theories to social organization.

Under communism people were treated as if they were atoms guided by strict and equal rules of behavior. Scientific pragmatism meant amorality replacing an inspired religious morality. Scientific principles superseded human individuality. The ideal of a singular and superior objective reality dominated the vision of its founders. Its horrific failure was due to a failure to understand the subjective diversity of people.

Reassertion of the diversity of people is a major theme in this new shift. Where the scientific paradigm sought to see everyone as the same underneath the surface (promulgated by the DNA discoveries of Watson and Crick), the new paradigm accepts differences in people. This reveals itself in many different ways, some very disturbing. In the former Soviet republics the rejection of the concept that everyone is alike finds form in violent hostility. Each ethnic group is demanding autonomy, recognition of its own right to be different and to determine its own directions and goals.

Though this is at its emotional peak in eastern Europe, these emotional sentiments run deep throughout the world. Native peoples are claiming their rights in Canada and the U.S. Quebec is pushing for recognition of special status.

In general, people, especially in the U.S., are trying to figure out how to live and get along in smaller, more locally accessible units, on more *tribal* levels. People are experimenting with social systems that function on more human scales. Interdependence as *individuals* is the key that people are searching for as an alternative to the large impersonal governmental systems that treat everyone alike. New tribal groupings have developed among people of like interests, ethnic origins, sexual orientation, beliefs, and location.

The common element is working together on a smaller scale. The original tribal impulses came from a need to work together with others to meet an individual's needs in the face of a dangerous, competitive external world. This new tribalism is propelled by the same needs in a new dangerous, competitive world (Utne, 1992).

Along with this, an interest in aboriginal lifestyles has blossomed. Thousands of people go out into nature on weekends for retreats with Robert Bly or maybe with a Huichol shaman from Mexico. The aboriginal ways that acknowledge the balance between internal and external reality is finding new validity. These shamans, many are realizing, had and still have incredible practical wisdom about human affairs, nature, and the connection between the two through healing.

Science, through the American Medical Association, still rejects the importance of the mind-body connection mastered by these aboriginal peoples. Seduced by the rational authority of science most intelligent people accepted a view that the body was like other objects in the world or like machines that could be fixed simply by removing the rust or replacing the broken parts.

When science did not have an immediate cure for cancer people began to turn elsewhere for help. Now, with the despair brought on by AIDS, people are again looking everywhere for help since the scientific medical approach has so little hope to offer. This massive search, if only by trial and error, has uncovered a number of alternatives to traditional medicine. Successful means of dealing with many medical and psychological problems have been discovered or rediscovered.

Scientists continue to disregard these significant findings even with the evidence in front of them. Some in the medical profession don't even want these alternatives explored scientifically. There has been sharp criticism of the U.S. government's proposal to investigate, scientifically, the claims of these alternatives. Science appears to be blinded by its own methods, not seeing the experiential facts that real people have encountered and know to be useful.

Suffering people don't care whether their treatment has scientific verification as long as significant improvements occur. And there have been too many successes to dismiss them all as chance. Even if the results are mainly psychological, a false sense of relief by scientific standards, they still work. They make people feel better. Perception, subjective reality, is as real and more important than an objective reality that doesn't do anything to solve a problem. It doesn't make logical sense but it is what happens.

Art plays a very important part in these changes. The principles that guide art are actually at the heart of the missing elements of the scientific approach. Examining hemispheric specialization of the brain makes this clearer. The concepts basic to science are governed by one side of the brain while those important to art are controlled by the other. The recent emphasis of education, during the past scientific revolution, has neglected this half of the brain. It might be said that the problem with the old paradigm was in its incomplete use of the brain. This gives a slightly different perspective on the issue but confirms the basic idea that the scientific paradigm is flawed and incomplete.

The importance of art in this new view has become publicly apparent. Art has emerged onto a new plain in the past few years. Through attacks on art and artists the power of art has been revealed. The ability of art to raise questions, to make people think, and possibly become creative themselves is a major threat to the status quo. These attacks are outward reactions to a changing uncertain world and art is seen as connected with these changes. Change is a threat because people do fear the unknown.

Art is about change. It doesn't accept anything the way it is. It is always searching and looking for new ways to view things and exposing the old as inadequate. The change that is happening is that kind of change. It is one that is breaking down old systems and beliefs. Art is directly connected to this.

The power of art can be seen very clearly in the media industry. Hollywood and the record industry are changing the world. Politicians court the endorsements of the media stars while the stars themselves raise money in massive quantities for the social issues that big government is failing to address adequately.

These media giants are often criticized as being somehow a perversion of society. They, in fact, are very much informed by the general arts climate to which they maintain strong connections. It is not uncommon to find rock stars who have classical music training or who have been to art school. Many movie stars have had, at least, passing experience in *legitimate* theater. They may not all attain the standards held for great artists but great fine artists and actors are their role models.

The arts have informed the changes in our society much more than most people would admit. Those that fear the changes have good reason to fear and object to the arts.

Another major indication of this shift comes from within science itself. Faced with its failure to be able to answer all questions logically it tries to incorporate into its theories wild cards to explain the anomalies. One such wild card, "**meaningful coincidences**," simply acknowledges exceptions to the conceptual framework of science without feeling the need for further explanation (Harman, 1990/91).

Undoubtedly, the hottest wild card is chaos theory. The theory seems to say that random or chaotic events which can't be explained, seen from the proper perspective, must fit into a higher sense of order. For example, though the purpose of random brain wave activity is not understood, the brain does appear to do some pretty useful things with them; therefore, the random activity must fit into a higher logical order.

This is the science that tries to dismiss the thousands of years of experience instilled in the Chinese physician or aboriginal medicine man whose practices don't make logical sense but whose acupuncture or sweat lodge ceremony relieves real pain and suffering. Science itself, through chaos theory, is acknowledging the change in the objectivity paradigm.

It is difficult to talk about

what the ramifications of this shift will be without using the same platitudes of previous paradigms. On one hand, a vision claiming new heights for all of human achievement in perfect harmony with the universe is seductive and appeals to the subjective, emotional self of the new paradigm. On the other hand, the old paradigm's objective, rational side predicts the acceptance of the ambiguity of the artist with a freer association of things that leads this way and that, always toward something new and surprising, but seldom to paradise. The new paradigm, you see, means accepting contradictions.

Certainly the recognition of the values of intuition, feeling, personal perception, and all the softer, warmer, wetter sides of life will bring a more humanistic approach to everything. People and all the universe will probably be thought about less like cold, hard objects and with much more compassion based on the acceptance of differences and our understanding of the fallibility of our subjective nature.

The arts should bring a richness to life without threatening people's basic self definitions. People should understand that a different view does not mean that their view is wrong. Science has implied that there was, ultimately, only one right view. The arts will be seen as a valuable tool for keeping society fresh and alive. Its constant questioning and reevaluating will help develop people's ability to live with uncertainty, seeing it as exciting, not threatening.

Science and art should not be separate. They should be understood as part of the same whole, both exploring the essential nature of this great mystery everyone is a part of. Both will continue to play with the pieces of the mystery that they discover and look to each other for inspiration. The sciences, more fully informed by the creative process, will stress inclusion, seeing the larger picture. Art will have a greater understanding of its place in the world and be more accessible to the general public, aiding their growth, development, and balance.

Changes will need to take place in education to accomplish this and these changes will inevitably occur. C. P. Snow noted the same need during the scientific revolution. Though the scientific revolution was already well under way, he felt that our education system lagged far behind (Snow, 1969). Sputnik did, eventually, throw education deeply and heavily into the scientific fray almost to the exclusion of everything else. This change came cataclysmically and with incredible force. The new emphasis on math and science made it seem like that was all that was important in life.

As the paradigm shifts in a new direction it is important that this doesn't happen again. Science isn't bad, it just isn't everything. There needs to be an integration of the arts and sciences in a way never conceived of before. Previous unions of these two did not have the tremendous specialization of talents dividing the population the way things are now. These two are symbolic of the two basic ways people encounter and understand the world.

Encouraging and developing more holistic curricula would go a long way in mediating the separations between people both intellectually and emotionally. Acknowledging the importance of the emotional and perceptual parts as essential parts of the whole person can heal the wounds that have been caused by splitting our being and denigrating certain parts of ourselves.

The integration must be in all fields of endeavor. Art and science simply represent the extremes of human activity. While integration is important and the connections between fields must be communicated, in-depth investigations in specialized areas can't be lost.

This is not as difficult as it might seem. Looking at the basic assumptions of these two extremes, art and science, the differences that have been elucidated here certainly exist, yet at the same time, it is also true that the goals for each are essentially the same and the procedures they utilize are almost identical.

In science: "creating, testing, and applying conceptual models is the chief *activity* of the scientist" (Harman, 1990/91). There would be little argument that this is also the "chief *activity*" of the artist. The values of the scientist are "openness of inquiry, healthy skepticism, and public validation" (Harman, 1990/91). Again, although the exact words would not be used in reference to the work of an artist, the concepts are the same.

Openness to new ideas is the bedrock of art. Skepticism is often at the core of the artist's view of society, the constant questioning that was mentioned earlier. And public validation? Well, there is probably nothing more public than the arts. Art is literally put out for public view and directly contingent upon public acceptance at some level.

There are three areas which cause problems. "***Objectivism***: the assumption of an objective world which one can hold at a distance and study separately from oneself" (Harman, 1990/91). This raises the problem upon which most of this paradigm shift thesis is based. Though an incredible gap is implied here, it becomes a minor one once the leap to a new vantage point is made. What is objectivity to a subjective viewer? It means that there are multiple realities, maybe even an infinite number of realities. This does not mean that all of them will or can be considered at the same time. Some will prove to be useful for specific purposes at specific times while others may become useful and meaningful at other times. All that is necessary is to look at the diversity of views represented in art. Each offers something. None holds all the answers. Science will not be diminished by this. It would continue to look for objective reality within clearly defined closed system for particular practical purposes. All life will be enriched once the values and limitations of each are appreciated.

Another problematic area is "***Positivism***: the assumption that the real world is what is physically measurable" (Harman, 1990/91). Considering that what is often measured by science is that which can't be experienced directly (subatomic forces) then, art can be thought of as the measure of the invisible, internal forces within people. In this way art fits within the criteria of *positivism*.

The last of these problem areas is more a procedure than a conceptual distinction. "***Reductionism***: the assumption that we come to really understanding a phenomenon through studying the behavior of its elemental parts" (Harman, 1990/91). The arts are often seen as an *additive* process, bringing together things to construct something new. This difference is just an illusion. The arts depend on a great deal of observation and analysis (*reductionism*, if you will) before it attempts to create. Science, on the other hand, does a lot of adding, pulling things together to create its models.

This is a simplification, to be sure, but there are many similarities and overlaps between these apparent polar opposites. Because of this, they can be used together very effectively in education. For example, scientists often use brainstorming as a useful method for exploring the attributes of a particular problem and for sugesting possible solutions. The scientist usually does this verbally and mathematically and occasionally visually. The artist is a specialist at this visual activity. Artists may make reams of sketches to explore the nature of a particular problem. Teaching the two together can only benefit both fields and help balance the individuals. Both the artist and the scientist work with metaphor, as well, in order to understand something new. The scientist cannot help but be enriched by the scope and variety of metaphor that artist deal with. In order to communicate more effectively, artists would benefit from the specificity of the metaphors scientists employ in their models of the world.

These are only a few examples of integrating the components of art and science. With more thought and exploration many others can easily be found. People can no longer afford to split our internal reality from external reality. Our future, the future of the planet, depends on our being whole, whole in ourselves and part of the whole of existence.

It is particularly important for those involved in the new technologies to take all this into consideration. The objective realities of machines can be enticing while the subjective lives of the people affected by them is messy. The multiple realities that subjectivity implies are not easy to work with. It is much cleaner to narrow the focus to easily measurable scientific realities and forget about people. This is no longer acceptable. Nuclear dump sites, wholesale pollution, uncontrolled development, and devastating human alienation has proven that. Scientific and technological advancements must be tempered with concern for and acceptance of the verity of human subjective needs.

Though people, in general, are already responding to these changes, understanding why they are feeling and behaving the way they are (rejecting science) will take a long time. It took a long time before there was any perceivable change at any level of society because of Einstein's discoveries except, maybe, within scientific circles on theoretical levels. Understanding by the public will take much longer and many will never understand it. Never the less they will respond in synchronicity with the new view the way people did with the scientific revolution.

What is happening to most people looks and feels like confusion because of the vastness of the changes. It is similar to moving to a new place. When you first get there everything is chaotic and confusing. The roads don't seem to go where you want to go. The buildings are all in the wrong places and no one is familiar. They all have strange quirks and customs. After awhile, however, you are no longer aware of these feelings, everything is in the right place, it is easy, almost automatic, to get around, and the people are the same as you.

The fears and resistance that are already being encountered and certainly will continue to be encountered in the future are devastating at times. Just as moving from one place to another causes severe trauma in some people. Often, children will only go kicking and screaming. This is all to be expected until the critical understanding or familiarity with the new takes place and then it will seem like the only way

The old ways will become archaic. How could anyone have believed in the old ways. As difficult as the transitions are and as much as many would resist, change is inevitable. Genies can't be put back in bottles. Just as someone can't unlearn how to ride a bicycle, the realization that the outside world is created as much by people as people are created by it can not be taken back either.

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The Art and Science of Hypermedia

by
Patricia Search

Throughout history, scientists and artists have used visual imagery to further their understanding of the world around them. In the twentieth century, advances in electronic technology, in particular computer graphics, have culminated in a new emphasis on the role of perception and visualization in art and science. Artists are using computer graphics and video to establish new forms of creative expression that challenge the limits of traditional media. Scientists, in turn, have access to high-speed computers that can turn their mathematical data into three-dimensional, animated graphics.

Until recently, the principle tools for electronic imaging in science and art were three-dimensional modeling, computer animation, and motion video. However, hypermedia computing now makes it possible to integrate these media, as well as text and audio recordings, into interactive programs that have the potential to expand the use of visualization in science, art, and other professional disciplines. Hypermedia is a powerful tool for restructuring conceptual relationships. Hypermedia programs allow users to randomly access information which makes it easier to create associations and synthesize ideas. In addition, multimedia databases provide a wide range of interpretive elements that enable users to evaluate information from different perspectives.

However, in order to tap the true potential of this medium as a visualization tool, users need interfaces that allow them to easily navigate through the database and retrieve information. This paper begins with a brief overview of some of the visualization issues in hypermedia interface design and describes a project called **HyperGlyphs**, a research project that is using a team of art professionals and computer scientists to develop guidelines for designing hypermedia interfaces. This paper highlights the results of this research and shows how the unique perspectives of artists and computer scientists have contributed to the successful resolution of conceptual and technical problems in hypermedia interface design.

Visualization in Hypermedia Interfaces

In order to use hypermedia to define new perspectives and conceptual relationships, the user must be able to easily access and organize information that is available in a large, multimedia

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database. In hardcopy media, there are temporal and spatial references for the user that indicate the structure and location of information. For example, by looking at the physical size of a book and by quickly flipping through the pages, a reader can see how much information is available and how that information is organized. However, with interactive computer programs, information appears and disappears on the screen as new visual data is displayed, leaving the user with few orientation references for accessing and retrieving data. As a result, users tend to become lost and disoriented as they navigate through a hypermedia database.

At Rensselaer Polytechnic Institute, a group of artists, art librarians, curators, and art historians are working with a team of computer scientists to resolve these problems in a research project called **HyperGlyphs**. The project is using a hypermedia program on contemporary art to develop guidelines for designing user interfaces that facilitate navigation and information retrieval. The research design of the HyperGlyphs project uses three essential criteria to achieve these objectives: an abstract art database, an interdisciplinary team of art professionals and computer scientists, and a methodology of iterative design.

The art database consists of images of abstract, contemporary art and conceptual writings about the art. Working with this type of symbolic information enables us to focus on the underlying visual and cognitive relationships between images and words without being distracted by representative and stylistic variables. This approach also makes it easier to identify new levels of interaction between language and design that can be used to visualize the information hierarchies in the user interface.

The research team consists of a group of art professionals and computer scientists. The art professionals comprise a focus group which plays an important role in the project because these professionals understand the power of visual perception and design in the communication process. In particular, they are sensitive to the interrelationships between words and images and can quickly identify the types of spatiotemporal cues that are needed for orientation and information retrieval.

Throughout the research, the HyperGlyphs project is using a process of iterative design to evaluate and modify the structure of the program and the interface screens. We began by interviewing the focus group to define the user's tasks and the objectives of the program. The program structure and the interface screens were designed and modified on paper before any code was written. Over 60 hours of interviews resulted in more than 300 iterations of screen designs. By developing preliminary designs on paper, we were able to evaluate issues of perception and cognition in hypermedia interfaces without being distracted by the technical problems that arise during software development.

When the focus group study was completed, we began developing a prototype program to implement the ideas that we had developed on paper. The process of iterative design continued as the computer scientists and the art professionals worked together to improve the conceptual and visual design of the program. The roles that both groups played in this process will be discussed in more detail later.

Designing Hypermedia Interfaces

In the HyperGlyphs project, the development of the user interface involved three major steps: (1) defining the semantic structure of the program; (2) using graphics and language to visualize that structure; and (3) designing a navigation function to visualize the user's path through the database.

Defining the Semantic Structure of the Program

In order to reduce confusion and enhance the creative output of the user, a hypermedia program must have a well-defined, semantic structure that is based on a conceptual model of the user's tasks. Research has shown that if users understand the structure of a document, they can use the program to their maximum advantage (Wright, 1991). It is important that the user interface establish a clearly articulated parallel between the user's tasks and the program design. The following steps can be used to accomplish this objective:

- Define the user's tasks;
- Map the tasks to specific program functions;
- Organize the database into a relational model;
- Identify the correlations between browsing and searching.

Define the user's tasks. The first step in defining the semantic structure of a hypermedia program is to analyze the objectives of the end user. As previously mentioned, we conducted over 60 hours of interviews with the focus group to determine the user's tasks and the objectives of the program. In addition to identifying conventional methods of organizing information, the focus group tried to specify new methods of accessing and structuring information that would only be feasible with an electronic database.

Map the tasks to specific program functions. The focus group carefully outlined the steps that were needed to accomplish each task and then mapped those steps to specific program functions. Cognitive walkthroughs (Lewis, Polson, Wharton, and Rieman, 1990) helped the group define the syntax of each function and in turn, visualize the human-computer interaction in the program. The research team and the focus group developed paper designs of the interface screens and continually evaluated and modified the user interface to clarify the conceptual model. Studies have shown that accurate cognitive maps are a requirement for successful navigation in hypermedia databases (Simpson and McKnight, 1990).

Organize the database into a relational model. A large database must be organized into chunks of information with labels that serve as orientation flags for the user (Wright, 1991). This step is accomplished by identifying the cognitive relationships between individual tasks and organizing the information in the database into small, task-oriented groups that support the user's objectives. This relational model creates a semantic structure that improves the effectiveness and efficiency of user navigation in a large database (Hara, Keller, and Wiederhold, 1991).

The conceptual breakdown of a multimedia database must be tailored to the needs of each application and target audience. In the HyperGlyphs project, the focus-group study indicated that a "narrow but deep" program structure was best for the end user. In this type of structure, the top level of the information hierarchy is restricted to a few groups but within each group, there are numerous links to information in the database. For example, in the HyperGlyphs program, there are only four categories in the top level of the program: Artwork, Exhibits, Bibliography, and Biography. Within each of these categories, the database is broken down into smaller groups of information which are defined by specific program functions.

Identify the correlations between browsing and searching. In hypermedia programs users must be able to browse and search for information as well as backtrack to retrieve information. It is difficult to specify the semantic structure of program functions that allow the user to accomplish these tasks because it is not always possible to delineate the conceptual boundaries between "browsing" and "searching."

For the user who needs to access specific information, it is easy to design a keyword search that allows the user to query specific information. Most users, however, tend to migrate back and forth between different levels of browsing and searching. Typically, users begin by casually browsing through a database. As they browse, they may become interested in a specific topic and decide to search for more detailed information. Although browsing inherently demands a flexible route into the database, the structure of the database itself must be clearly defined and labeled so that users can quickly search for specific information as needed.

The HyperGlyphs project addresses this problem with a *sort* function that allows the user to organize the information in the database according to a number of predefined categories such as year, author or artist, publication, and exhibits. This function provides the user with adequate flexibility for browsing through information, while at the same time, providing labels that enable the user to backtrack and locate specific data (see Figure 1). Researchers have pointed out that users are less likely to feel disoriented or lost when there is a predefined path that narrows their options for navigation (Zellweger, 1989).

Visualizing the Program Structure

Graphics as well as language are critical elements in visualizing the semantic structure of the program and the syntax of the program functions. Visualization techniques will vary with different hypermedia programs depending on the application. Examples from the HyperGlyphs project can provide some general guidelines for using color and layout, menus, and language to establish navigational cues for the user.

Color and layout. In the HyperGlyphs program, four icons represent the top-level divisions of the database (Artwork, Exhibits, Bibliography, and Biography). There are two versions of each icon: a colored version and a gray version. When an icon is selected, it is highlighted in color to serve as an orientation reference while the

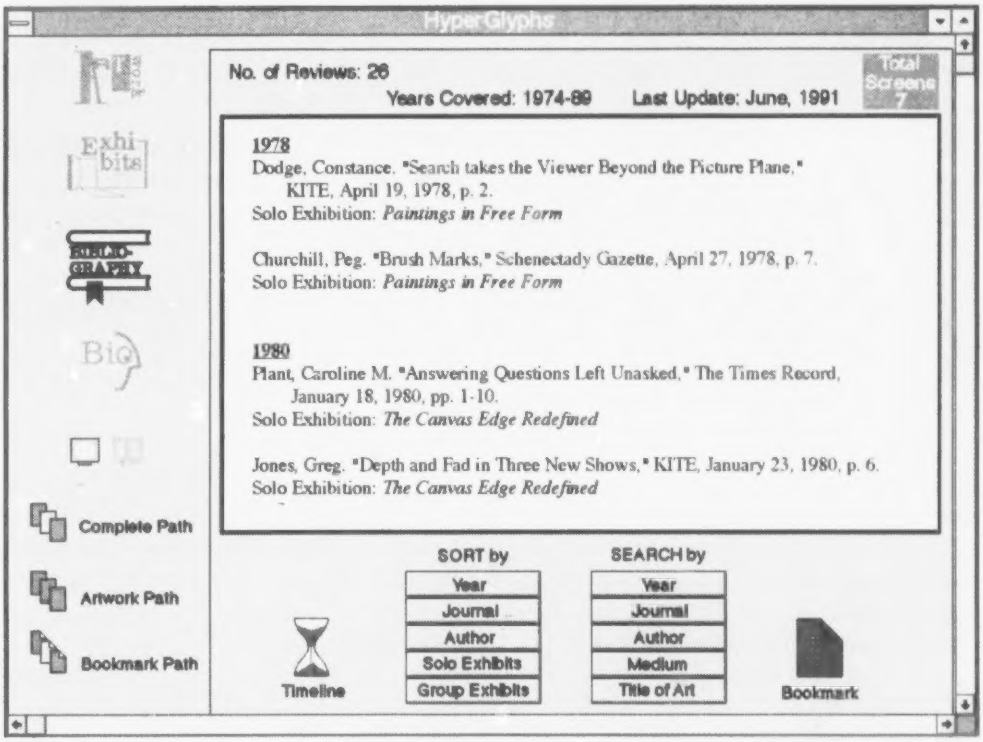
HyperGlyphs
Exhibits
BIBLIO-GRAPHY
Bio
Complete Path
Artwork Path
Bookmark Path
Total Screens 7
Timeline
SORT by
Year
Journal
Author
Solo Exhibits
Group Exhibits
SEARCH by
Year
Journal
Author
Medium
Title of Art
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Figure 1. A *sort* function allows users to sort all the information in the database according to predefined categories. This function enables users to browse or locate specific data. Another function that performs keyword searches is also available for highly structured queries.

other icons remain gray. Each icon is characterized by a unique color which is repeated in a slightly lighter value in other graphics that appear on the screens within each of the main categories (e.g., the timeline and bookmark icons). This color coding provides the user with a visual outline of the program structure.

The layout of information on the screens also plays an important role in the visualization of the program structure and the syntax of the program functions. The four main icons are arranged in a vertical list to reflect the top-down hierarchy of the program structure. The buttons for the *sort* and *search* functions are also arranged vertically to underscore the hierarchial structure of the program and to emphasize the parallel syntax of the two functions.

Menus. The HyperGlyphs program uses permanent menus that are visible at all times (as opposed to pull-down or pop-up menus) to identify the user's location in the database and to remind the user how to access information. This design reduces the cognitive overhead for the user because once information is located, it is not necessary to remember all the steps that were required to get to that section of the database. Research has shown that repetition is an important navigational aid in speech-controlled hypermedia programs (Barry, 1991). However, the use of repetition as a navigational aid should not be restricted to audio programs. By keeping menu options visible at all times in a hypermedia program, repetition can also be used to facilitate navigation and information retrieval in audio-visual interfaces by simplifying the perceptual complexity of the multimedia stimuli.

Language. In the HyperGlyphs project, language is also an important design element in the visualization of the database structure and the syntax of the program functions. For example, in the user interface there are textual lists of options for database sorts and keyword searches (see Figure 1). These categories define the organizational structure of the database and provide labels for navigation and information retrieval. Language is also used to define the syntax of functions and direct the input of the user. For example, the phrase "Search by..." is located at the top of the list of options for the keyword searches. The focus group evaluated the phrases "Search *by*..." and "Search *for*..." as possible headers for the list. "Search by..." was selected because the phrase tends to limit the user's input to a specific list of requests while "Search for..." implies that the user is free to search for a much wider range of information--a process that can lead to confusion and disorientation in the program.

In the design of human-computer interfaces, there has been considerable support for the use of "natural language" in interactive computer programs because natural dialog is an inherent part of social interaction and because it can be incorporated into a wide variety of media and forms of communication (Waterworth and Chignell, 1989). In the HyperGlyphs project, language is an important visualization tool that improves navigation by clarifying the interpretation of the program's structure and interactive functions.

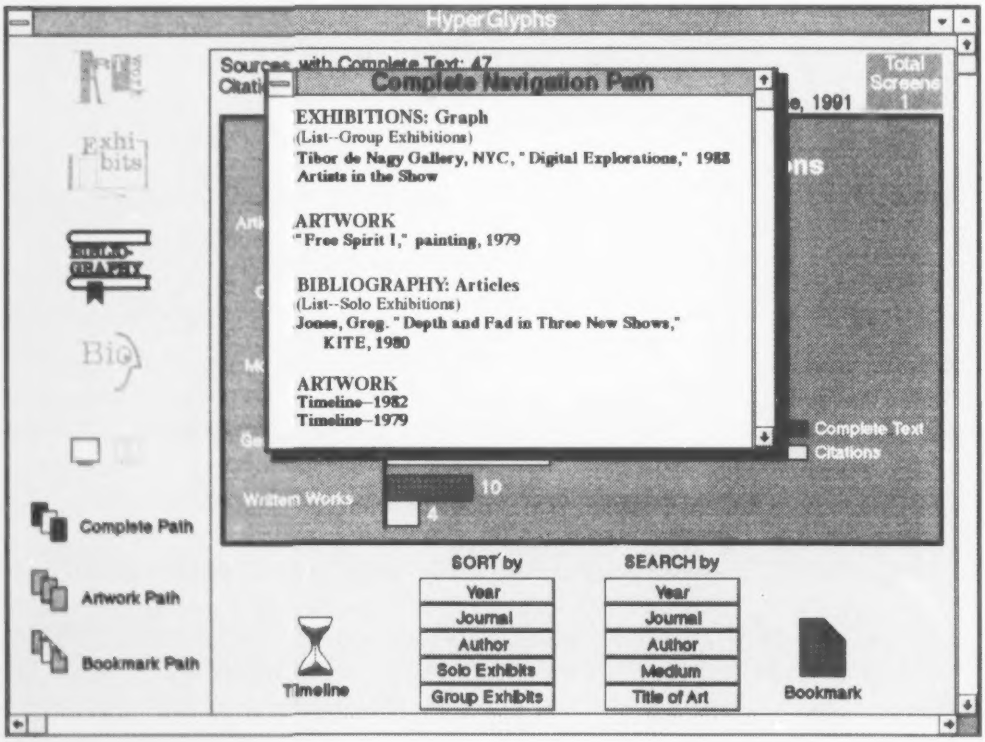
Designing a Navigation Function

Hypermedia programs should provide a method of visualizing the user's path through the database. Research has shown that hypermedia navigation is improved if the user can see a list of all the information that has been accessed (Simpson, 1989). Many hypermedia programs have implemented navigation functions that track the user's path and attempt to accomplish several, if not all, of the following objectives:

- Allow the user to backtrack and retrieve information;
- Locate the user's position in the database;
- Identify what information has been accessed and what additional information is available;
- Show the hierarchial and associative links in the database.

These multipurpose navigation functions often use tree-structure diagrams to visualize the hierarchial and associative links in the database and the user's position in the database structure (a "You are here" approach). However, a navigation function that attempts to show too many relationships contributes to the confusion of navigating through a hypermedia database. The objectives of a navigation function should be clearly defined and limited to a single goal. For example, if the purpose of the navigation function is to allow the user to backtrack and retrieve all the information that the user has previously accessed, the path does not have to show all the remaining, unaccessed information in the database. Program functions that provide overviews of the database or functions that allow the user to sort or search for information can provide that type of feedback.

The HyperGlyphs project limits the objectives of the navigation function to backtracking and information retrieval. The focus group evaluated several methods of visualizing the path, such as overlapping windows and small icons of the screens, but rejected those approaches because they were technically and perceptually unfeasible for the visualization of long navigation paths. The final solution was a textual list of references to the information that the user has accessed (see Figure 2). This linear, sequential representation of the user's path through the database accurately represents the temporal characteristics of the user's interaction with the program. Although hypermedia programs support non-linear, random access to information, the *sequence* of user actions is really a linear, one-directional event that occurs over time.



Complete Navigation Path

EXHIBITIONS: Graph
(List--Group Exhibitions)
Tibor de Nagy Gallery, NYC, "Digital Explorations," 1988
Artists in the Show

ARTWORK
"Free Spirit I," painting, 1979

BIBLIOGRAPHY: Articles
(List--Solo Exhibitions)
Jones, Greg. "Depth and Fad in Three New Shows," KITE, 1980

ARTWORK
Timeline--1982
Timeline--1979

HyperGlyphs
Sources with Complete Text: 47
e, 1991
Total Screens 1
Exhi bits
BIBLIO-GRAPHY
Bio
Complete Text
Citations
Written Works
10
4
Complete Path
Artwork Path
Bookmark Path
Timeline
SORT by
Year
Journal
Author
Solo Exhibits
Group Exhibits
SEARCH by
Year
Journal
Author
Medium
Title of Art
Bookmark

Figure 2. The navigation function tracks the user's path and uses typographical cues to designate the different screens of information that the user has accessed. The user can return to a screen by selecting an item from the list.

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Formatting this list for readability and comprehension posed several problems. Indenting the references under their respective categorical headings created a conceptual hierarchy that did not necessarily reflect the user's associations between the ideas. The current format in the program uses left-justified text with variations in typography to differentiate the steps in the path (see Figure 2). These visual cues allow the user to easily locate individual entries without defining conceptual hierarchies. Future versions of this navigation path will use color and icons to enhance the textual list.

The Interaction of Art and Science

Hypermedia interfaces must visualize the semantic structure of the program, the organization of the database, and the syntax of the program functions. The interface design must clearly articulate a conceptual model of the user's tasks and objectives.

In the HyperGlyphs project, the art professionals and computer scientists contributed distinctly different perspectives to the research. Computer scientists, for example, are trained to focus on the product of the programming design not the process itself (Linn and Clancy, 1992). As a result, our programmers were quick to propose existing software conventions for solutions to problems, instead of letting the problem-solving process itself define solutions that were tailored to the objectives of the application. The computer scientists also focused on the syntax of the programming language and often used the interface design to visualize the syntax of the underlying software rather than the user's tasks.

The art professionals, on the other hand, were able to define the user's tasks and visualize the procedures that were required to accomplish those tasks. They were able to define the semantic structure of the program and the syntax of the program functions by analyzing the steps that were needed to accomplish each task, and they were able to identify parallel relationships between tasks and procedures. They did not enter the project with any preconceived ideas about the way the program should be designed. Instead, they let the *process* of defining the program structure dictate the conceptual and visual design of the interface.

The interaction of these diverse perspectives enhanced the project in many ways. By working with designers who could visualize the semantic relationships in the program, the computer scientists gained new insights into ways to access data and structure links in the database. In turn, by subjecting all the conceptual proposals of the focus group to the logical scrutiny of the computer scientists, it was possible to uncover some of the subtle ambiguities in verbal and visual communication that can create confusion in hypermedia navigation. For example, the focus group recommended the implementation of a function that would allow the user to move back and forth between screens of information by using buttons labeled "Previous Step" and "Return." However, when the programmers tried to develop an algorithm for this function, they identified conceptual problems with this approach because neither term specified exactly how far the user would move. The term "Previous Step" could mean one step back, several steps back, or all the way back to the beginning. Similarly, "Return" does not specify how many steps the user will move nor does it indicate direction (forward or backward). A logical analysis of the algorithm for the function revealed conceptual ambiguities that the cognitive walkthroughs in the focus-group study had not identified.

Conclusion

Although scientists and artists analyze problems from diverse perspectives, both groups share a mutual need to use visualization to define and clarify relationships. Martin Kemp points out that visual imagery has created an historical affinity between the sciences and the visual arts because through vision, scientists and artists can study nature and understand the rules that define the underlying structure of the real, physical world (Kemp, 1990).

However, in the HyperGlyphs project, this intellectual affinity involved more than the use of visual perception to understand the physical environment. The communication objectives of this project required the use of visualization techniques to articulate task-oriented procedures. As a result, the perspectives of scientists and artists were linked by the mutual need to identify the underlying, logical structure of the visualization process itself. At all stages of the research, the computer scientists, artists, art librarians, curators, and art historians used varying degrees of logic to transform complex observations into visual statements that defined a set of procedures. The art professionals used the logic and resolution defined by the Gestalt laws of perception and the semiotics of design, while the computer scientists used the analytical perspectives that are rooted in the scientific logic of discrete mathematics. Both groups had to define a logical structure that could translate the abstract process of perception into concrete functions that would enable the user to accomplish a set of tasks.

This emphasis on the use of electronic imaging to visualize abstract, interactive processes can be seen in many areas of scientific research and in many forms of contemporary art. This mutual need to visualize the underlying structure of perception and cognition is breaking down the conceptual barriers between science and art and creating a dynamic dialog between professionals in both fields. This interaction will lead to the development of multidimensional communication models that integrate audio-visual stimuli and cognitive, information structures into an expansive view of reality. In the area of user interface design, these communication structures will lead to "transparent" interfaces that make it easier for users to organize information and visualize new relationships.

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89

Visualization in Science and the Arts

by
Susan King Roth

To *visualize* is "to recall or form mental images or pictures (Random House, 1991)." The term *visualization* is employed in a number of ways. As popularized in the media it refers to the act of visualizing success in sports or other arenas of endeavor. This, however, is *not* the meaning explored here. Visualization as a factor of intelligence includes the mental manipulation of spatial configurations and has been associated with spatial abilites, creative thinking, and conceptual problem solving. The Educational Testing Service, which publishes standardized tests for the assessment of cognitive skills and abilities, defines visualization as "the ability to manipulate or transform the image of spatial patterns into other arrangements (Ekstrom et al., 1976)." The process involves holding the configuration in short-term memory and performing serial operations such as rotation or reflection. It is closely related to problem-solving methods and concept generation in fields as diverse as science, art, and design.

Visualization refers to both an internal process (the formation and manipulation of mental imagery) and an external means of communication (the creation of graphic imagery). See fig.1. Graphic imagery such as three-dimensional models may also be used for theory development as well as for communication of concepts.

INTERNAL PROCESS:
Formation and Manipulation
of Mental Imagery
for creative thinking and
problem-solving

EXTERNAL
COMMUNICATION:
Graphic Imagery
including models, charts,
computer simulations

Fig. 1

Because mental imagery may be analogous to real-life phenomena the manipulation of mental images can assist in the process of problem-solving related to these phenomena. According to Antonietti: "Mental images may provide a simplified representation of the content of the cognitive task...Moreover, images permit representation of objects and events in an analogue format, so that it is possible mentally to anticipate transformation of the external world (1991)." There are numerous reports of visualization being used in this way by scientists and mathematicians, for the solution of problems that would not yield to attack by more analytical methods. Shepard (1978) cites several accounts of such methods used by prominent individuals throughout history in the development of significant contributions to science and mathematics.

For example, Albert Einstein used visualization to arrive at the theory of relativity and was able to "see" the logic of the theory through the manipulation of analog images. Lecturing at the Prussian Academy of Sciences in 1921 he explained the concept of spherical space through a description of visual imagery: "...by using as a crutch the practice in thinking and visualization which Euclidean geometry gives us, we have acquired a mental picture of spherical geometry. We may without difficulty impart more depth and vigour to these ideas by carrying out special imaginary constructions (French, 1979)." Quoted in Shepard, Einstein said: "There is no logical way to the discovery of these elemental laws. There is only the way of intuition, which is helped by a feeling for the order lying behind the appearance."

Einstein's predecessor, Michael Faraday, had an aversion to writing and lacked an education in mathematics. Yet he was able to visualize "lines of force" curving in space around magnets and electric currents, thus originating the conception of magnetic and electric fields. Jacques Hadamard, a noted mathematician, wrote: "I insist that words are totally absent from my mind when I really think." Shepard also recounts the story of James Watt, who invented the steam engine, as he worked for two years to make the engine feasible, finally coming upon a solution during an afternoon walk when the engine and its parts and relationships appeared completely resolved in his mind.

And finally, the German chemist Kekulé discovered the molecular structure of benzene, revolutionizing organic chemistry, through visualization. "Seeing" atoms playing before his eyes while dozing, they suddenly formed a long chain which twisted and turned like a snake. Kekulé writes: "But look! What was that? One of the snakes had seized hold of its own tail, and the form whirled mockingly before my eyes. As if by a flash of lightning, I awoke (Adams, 1979)." He realized that the structure of organic compounds such as benzene was a closed ring. Many other instances have been recorded in which visualization was used to arrive at a solution to scientific or mathematical problems through the manipulation of mental images.

It is perhaps less surprising that artists and designers make use of visualization to facilitate the creative process. Although the products of design and art are different – design involves the development of images and objects with utilitarian as well as aesthetic value – the process of generating and expressing ideas is similar. Because of longterm experience with visual form, it is likely that artists and designers have a highly-developed ability to visualize. A study conducted by R. Davies and R.J. Talbot (1987) into the lives of 35 Royal Designers for Industry in the United Kingdom revealed in fact that they "often described a facility in using mental imagery, for example as a multi-sensory and dynamic, mental sketch pad; using mental rotation and scanning images..." Lord states: "The ability to mentally juxtapose, manipulate, and rotate an object and to create structures in the mind from written or verbal directions has been shown to be a tremendous benefit in many of today's vocations...artists, architects, engineers and craftsmen scored consistently higher on tests for visuo-spatial accuracy than most other trades... (1987)."

The sculptor Henry Moore wrote that the sculptor "gets the solid shape, as it were, inside his head...He mentally visualizes a complex form from all round itself: he knows while he looks at one side what the other side is like...(Ghiselin, 1952)." Leonardo da Vinci made the observation that creative processes were prompted by his examination of stains on the wall "you may discover a resemblance to various landscapes, beautified with mountains, rivers, rocks, trees...or again you may see battles and figures in action, or strange faces and costumes, and an endless variety of objects which could reduce to complete and well-drawn forms (Da Vinci)." His notebooks were full of sketches and drawings of objects and scenes drawn from observation and from the imagination (see fig. 2).

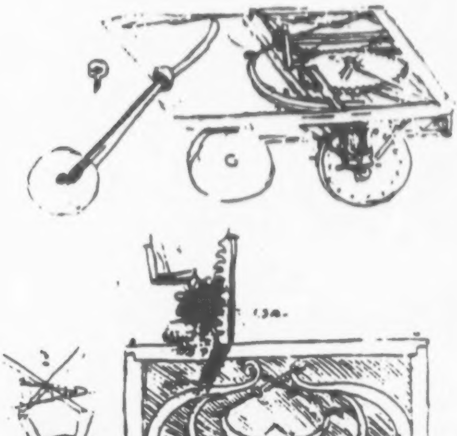


Fig.2.Leonardo's horseless wagon. *The Inventions of Leonardo da Vinci*. Macmillan.

Many artists and designers work from a rough sketch to more finished sketch and then on to models, prototypes, or the final product of the process. Used in this way the graphic representation of mental images, or conceptual sketching, acts as a visual notation system. The quick sketches which characterize the beginning stages of the design process are made not for communication with others but as a way of recording concepts leading to the development of new ideas, a visual aid for continuing idea generation. The concept is often displayed in several views, or important details may be enlarged and examined visually (see fig.3).

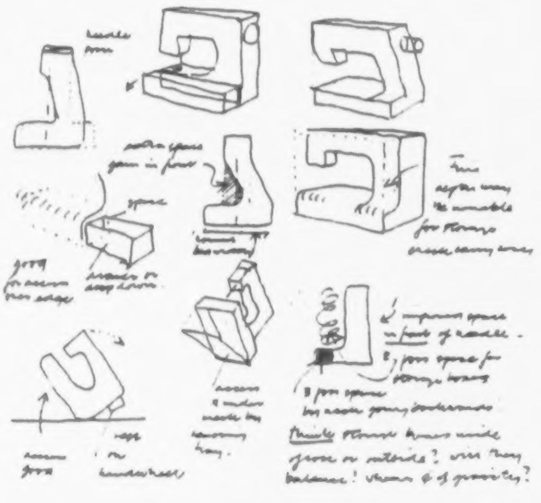


Fig. 3. Concept sketches for design of a sewing machine. Pentagram. *Living By Design*.

Several books have been written on this process; one is *Rapid Viz* by Hanks and Belliston (1981), another is *Experiences in Visual Thinking* by Robert McKim (1972). Courses have been developed at various universities such as Stanford and The Ohio State University to enhance mental and graphic visualization skills for engineering and design students.

For the most part, though, there is a lack of emphasis on visual skill development in the educational system. Dr. Howard Gardner of Harvard University has argued that "schools ignore valuable skills like the spatial abilities of an architect or an engineer (Fiske, 1989)." How many people have well-developed drawing abilities or use visual notation as often as they use written notation? The ability to communicate through graphic images often atrophies after the elementary education level, where it is accorded some degree of importance.

Graphic imagery is used for the communication of information as well as for the generation of concepts. Models and diagrams are two methods of representing information and may aid in developing theories related to structure or relationships in three-dimensional space. The model of the DNA double helix constructed by Nobel prize-winners Watson and Crick was built in order to visualize a complex structure through direct interaction with the model; it also served to illustrate the proposed structure to others. Linus Pauling's sketch-model of the protein molecule (shown unfolded) is another example (Fig. 4).

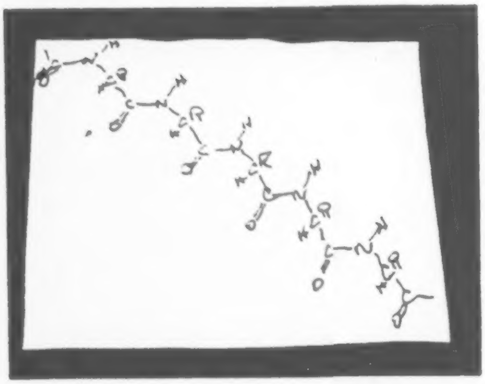
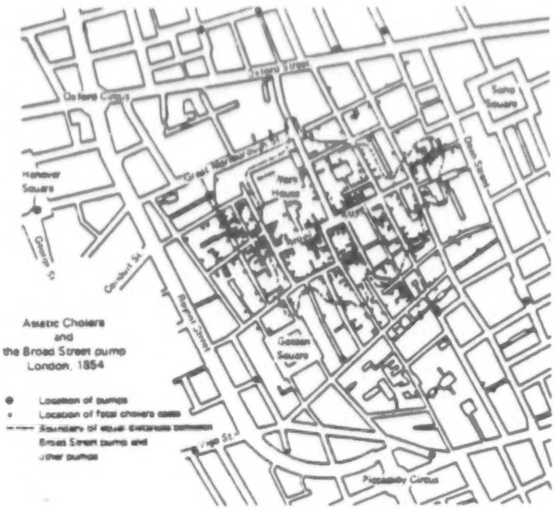


Fig. 4. Paper sketch-model of protein molecule by Linus Pauling. (Judson, H.. *The Search for Solutions*. New York: Holt, Rinehart, and Winston, 1980.)

Also in this category are information graphics (charts, maps, graphs, illustrations, etc.), computer simulations, and imaging from medical technologies such as X-rays and MRI scans. In each case the image not only conveys basic information, but also allows the viewer to see relationships or patterns that would not otherwise be apparent. As an example, John Snow's map of London (Fig.5) is a "spot map" showing the worst areas of infection with asiatic cholera, indicating an apparent connection between the Broad Street Pump and spread of the disease.



Oxford Street
Oxford Circus
Soho Square
Hanover Square
Great Marlborough St
Dean Street
George St
Conduit St
Regent Street
Golden Square
Vigo St
Piccadilly Circus
Asiatic Cholera
and
the Broad Street pump
London, 1854
Location of pumps
Location of fatal cholera cases
Boundary of equal distances between
Broad Street pump and
other pumps

Fig. 5. J. Snow's map of London with areas of infection with the cholera epidemic marked.. (J. Fox, C. Hall, and L. Elveback. *Epidemiology*. New York: Macmillan, 1970.)

Aids to visual perception such as the microscope, the telescope, and the satellite camera have opened up new worlds for visual exploration. The visual evidence gathered from these devices has prompted the development of theory and brought us closer to understanding the structure of the universe and its contents.

New technologies in the area of computer graphics and simulations communicate information not available through previous methods of visualization. Medical imaging makes possible a look into the living human body, illuminating areas formerly hidden from view. Designed products are modelled and manipulated on a computer, which can be connected to machines that produce three-dimensional models of the computer image. The power of computer simulations and modelling represents other ways of both knowing and communicating, and the current shift from print to electronic media will increase the need to educate the next generation for the effective use and interpretation of visual images.

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RESEARCH & THEORY

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Covert and Overt Rehearsal Strategies Used to Complement Visualization

by
Carol A. Dwyer, Mike Moore, and Francis Dwyer

Introduction

Research by Dwyer (1978; 1987) has shown that systematically designed and developed visual illustrations properly integrated into traditional instructional sequences are not always a sufficient condition for increasing students' achievement. In many cases, visualization must be used in conjunction with an additional independent variable to optimize information acquisition. Many of these variables are called rehearsal strategies in that they require the student to interact more intensely with the content material, thereby facilitating the movement of information from short-term into long-term memory. This additional rehearsal activity (interaction with the content) encourages the students to think about what they are doing and to encourage their development of relationships among the facts, concepts, procedures, etc. presented in the instruction (Wittrock,1981; Wittrock,,1986; Weinstein & Mayer,1986). Specifically, the purpose of this study was to examine the effect of visuals possessing different amounts of realistic detail and the effects of integrating covert and overt rehearsal strategies into visually complemented prose instruction.

Method

Arrangements

One hundred twenty-eight students at Penn State University were randomly assigned to four treatments. Students in each treatment received a 37-page instructional module of approximately 1800 words describing the physiology and functions of the human heart. Each page contained a 2 1/2 inch x 3 1/2 inch illustration of the human heart which was designed to illustrate the printed content contained on each frame. Simple line drawings complemented the instruction for students in Treatments 1 and 2; detailed line drawings were used to complement the instruction in Treatments 3 and 4. The simple line drawings were defined as possessing low amounts of realistic detail and the detailed line drawings as possessing greater amounts of realistic detail.

Each treatment was designed in the programmed instruction format. Each instructional frame contained a question on the bottom which asked the student whether the illustrations correctly illustrated the printed material it was designed to complement. Students in Treatments 1 and 3 responded covertly (mentally) to the yes or no question, whereas students in Treatments 2 and 4 overtly recorded their responses on answer sheets. Visual reinforcement of the accuracy of their response to the printed questions was presented on the following page. Illustrations for feedback were labeled correct if the visual accurately portrayed the information being presented verbally. Visuals for feedback were labeled corrected if the visual on the previous page did not accurately portray the information being presented, and the "corrected visual" was the correct portrayal.

Criterion Measures

Students in each treatment received their respective instructional presentation and then completed four individual criterion tests. Scores on these tests were combined into an 80-item total criterion test. The objective of each test was as follows: (a) drawing test—to evaluate learning of specific locations of the various patterns, structures and positions of the parts of the heart, (b) identification test—to measure transfer of learning (i.e., the ability to identify numbered parts of a diagram of the heart from information received in the instruction), (c) terminology test—to evaluate students' knowledge of referents for specific symbols, (d) comprehension test—to measure understanding of the heart, its parts and internal operations, and (e) total criterion test— to measure the students' total understanding of the concepts presented.

Results and Discussion

Analyses indicated that when students received the covert and overt treatments (Treatment 1 versus Treatment 2) of the simple line drawings, significant differences in favor of the covert version (Treatment 1 > Treatment 2) were found to exist on the terminology (t(1,62)=3.99, p. < .01), comprehension (t(1,62=7.06, p. < .01), and total criterion tests (t(1,62)=4.16, p. < .01). In comparing the covert and overt treatments complemented by detailed line drawings, the covert treatment (Treatment 3) was significantly more effective than the overt treatment (Treatment 4) on all criterion measures (drawing, t(1,61)=4.82, p. < .01; identification, t(1,62)=2.08, p. < .05; terminology, t(1,62)=2.26, p< .05; comprehension, t(1,62)=12.88, p. < .01); total t(1,62)=5.68, p. < .01).

In comparing the results of student achievement attained as a result of receiving the covert simple line treatment (Treatment 1) and the covert detailed line drawing treatment (Treatment 3), students receiving the latter (Treatment 3) achieved significantly higher mean scores than students given the simple line Treatment (Treatment 1) on the identification (t(1,58)=2.39, p. < .05), comprehension (t(1,58)=2.98, p. < .05) and total criterion tests (t(1,58)=2.06, p. < .05). Insignificant differences in mean student achievement were found to exist on the terminology tests. In comparing the mean achievement of students receiving the overt versions of the line drawing (Treatment 2) and detailed drawing treatments (Treatment 4), insignificant differences were obtained on all criterion measures.

The results indicated that when students received the detailed drawing treatments, those who had the covert rehearsal achieved significantly higher mean scores on all criterion measures. The same pattern was found for students who received the line drawing treatment on the terminology, comprehension, and total criterion measures. When the achievement of students who received the line drawing and detailed line drawing treatment, complemented by covert rehearsal was examined, those students who received the detailed line treatment achieved significantly higher mean scores than did students who received the line treatment. Insignificant differences in achievement on all criterion measures were found to exist on all criterion measures among students who received the simple and detailed line drawings complemented by overt rehearsal.

The superiority of the covert responses was unexpected since most of the related research (Dwyer,1978; Dwyer,1987) indicates that overt responses instigate deeper levels of information processing and thereby results in greater levels of information acquisition. The type of students who participated in this study may have influenced the outcome since they were of high ability in an academic curriculum and were more likely to use their own assimilative encoding strategies regardless of the topic or instructional manipulation imposed by the experimental treatments. It is possible that the process of recording their responses to questions interrupted the use of their already established formal learning strategies and hindered rather than facilitated information, acquisition and subsequent recall (Walko & Dwyer,1990). This interpretation seems to derive some support from prior research (Corey, 1955; Palmatien & McNich,1972) which showed that when students are involved in overt activity the process becomes a deterrent to learning.

When the covert versions of the line and detailed drawings were compared, the students who received the detailed line drawings achieved significantly higher mean scores on all criterion measures. These results are similar to previous findings (Dwyer,1978; Dwyer,1987) which indicate that when students are permitted to initiate their own learning strategies, the realistic detail (the detailed line drawing) which contains the greatest amount of instructional stimuli usually is most effective in facilitating optimum learning. This finding was not replicated when the overt versions of the line and detailed treatments were compared. No significant differences were found to exist between the two types of drawings on all criterion measures. One explanation for this finding may be that students in interacting with the detailed drawings only interacted with the basic visual structures in the detailed drawings to acquire the information necessary to respond to the questions. Consequently, they did not interact with the additional information in the detailed drawings to maximize information acquisition.

This study which examined the effect of covert and overt rehearsal strategies used to complement visualized instruction (possessing different amounts of realistic detail) raises a number of questions for further research: (a) what would be the results if high school rather than college students participated in the study, (b) would a profile of performance similar to this study be retained if, instead of immediate posttesting, a delayed test was administered two to three weeks later, and (c) would the profile of achievement on each criterion test be retained if visual rather than verbal tests were used to assess student achievement from the visually complemented instruction.

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Seeing Through the Glitz: Commercial Literacy for Students

by

Kathryn Oliver Hillyer

INTRODUCTION

Children are bombarded by advertising as they watch television, which may be as much as three to five hours a day (Annenberg in Notar, 1989). In the early 1970's Barcus (cited in Condry, Bence & Scheibe, 1988) estimated that children saw about 20,000 television commercials per year. Condry, et al., wrote in 1988,

> If the average child currently watches about 4 hours of television a day ...with nearly 30 nonprogram messages an hour, ...an ordinary child viewer would be exposed to more than 40,000 nonprogram messages a year, including well over 30,000 product commercials (p. 266).

Many researchers have shown that young children do not differentiate between the program and nonprogram spots, such as commercials and public service announcements (Allen, Wright & Laminack, 1988; Blosser & Roberts, 1985; Condry, et al., 1988; Kunkel & Roberts, 1991; Levin, Petros & Petrella, 1982; Meringoff & Lesser, 1980). As they get older, children become better able to identify commercials, but it isn't until they are around eight years old that they really understand the selling intent of these spots (Blosser & Roberts, 1985; Kunkel & Roberts 1991). A variety of techniques are used to make the product being advertised seem better than any other, but children have a difficult time accepting the fact that "the exciting, fast-moving game shown on the TV screen is not as exciting in real life" (Kaye, 1979). Kehl (1983) writes that "just as the reading of literature requires a willing suspension of disbelief, so a perceptive reading of advertisement requires a willed suspension of belief" (p. 34). This suspension of belief can also be applied to "reading" a television commercial.

This article examines television advertising aimed at children, including its regulation, techniques, and research on its effects. It then focuses more closely on one aspect, sexual stereotypes in commercials, including an analysis of current com-mercials. Finally, a Commercial Literacy unit will be presented, used with fourth grade students in conjunction with their classroom teachers.

ADVERTISING IN CHILDREN'S PROGRAMS

History

With the growth of television programming for children came a growth in advertising targeted specifically at them. By the end of the 1960's Barcus found an average of almost 12 minutes of commercials per hour on Saturday morning. The FCC stepped in and developed guidelines, requiring stations to limit the amount of advertising presented during children's programs. They also required a clear separation between commercials and program content, including "bumpers," and prohibited host selling and program-length commercials. However, in 1984, the FCC removed all limitations on commercial content, justifying this move by claiming that viewers would stop watching if commercials became too intrusive and this would cause stations to regulate themselves (Kunkel & Roberts, 1991). Increasing amounts of advertising resulted and the FCC decision was successfully appealed where it regarded children's programming.

Advertising Techniques

Advertisers employ a variety of techniques to get their message across to children. Some use animation, although toy commercials tend to use live action (Barcus, 1981). Animated figures interact with live children, objects are transformed, characters crash through walls or are attacked by wild animals. Repetition and unusual sound effects are also often employed. Dramatic skits are used, showing how much fun the television characters are having using the product.

Kane (1980) lists six different advertising techniques: (a) *image advertising*, where the product is associated with certain people, places, or activities; (b) *bandwagoning*, urging viewers to join the crowd, everybody who's anybody is using this product; (c) the *testimonial*, with a famous person endorsing the product; (d) *plain folks*, enabling the viewer to identify with someone like themself; (e) *name calling*, comparing with other products, which are, naturally, inferior; and (f) *weasels*, implying a message or claim by using such words as "virtually," "usually," or "can help." Advertisers vary the pace and scale (making the product look much larger), use voice-overs, and carefully select actors. Notar (1989) adds that the average sound level is usually higher than the regular program, and the message implied may be "advertisers' products will make you happy and popular," or "sugar products are selected by the best and the brightest" (p. 66). She goes on to point out that the graphics, photography, and audio are far superior to the neighboring programming, which isn't surprising, considering that advertisers spend over $800 million a year on commercials targeted at children under 12 (Notar, 1989).

The appeals in children's advertising are presented both verbally and visually. The verbal messages are (a) *assertions*, which are statements made in the ad about the potential benefits of the product to the user; (b) *attributed qualities*, such as "tastes great" or "the best," and are difficult to verify; (c) *product properties*, physical descriptions of the product, referring to size, color, or sturdiness; and (d) *product composition*, which is information on materials used in the product (Barcus, 1981). Most commercials are indirect appeals to the viewer, implying that they will be happier/stronger/prettier/more popular with this product. A mood is established to make the audience less guarded.

EFFECTS OF ADVERTISING ON CHILDREN

A great deal of research has been done on the effects of television programs and commercials on children and this article will only introduce a small portion. One group studied the effects of commercials on children's play behavior and found that:

> Children who saw programs with high levels of action, particularly when the content was violent, were less imaginative and slightly more aggressive than those who saw a program with low action and violence or saw no television at all (Greer, Potts, Wright, & Huston, 1982).

Kunkel and Roberts (1991) cite a study by Ward, Wackman and Wartella who found that barely over half of the experimental group of 6- and 7-year-olds knew that the commercials they watched wanted them to buy the product. Identification of commercials by name precedes recognition of

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persuasive intent (Blosser & Roberts, 1985). Children enjoy watching commercials, with their high-tech appearance, rapid action, and simplistic storylines. Cullingford (1984) states that the four main reasons they may like a particular advertisement are the personalities, gimmicks, humor, and songs. Advertisers exploit this thoroughly.

Sex Role Stereotypes

Commercials are major culprits in perpetuating sex role stereotypes and this situation has not changed much in the past ten years (Lovdal, 1989; Riffe, Goldson, Saxton, & Yu, 1989; Signorielli, 1989). How people are presented in advertisements can affect children's perception of social reality (Riffe, et al., 1989; Greenfield, 1984). Does this have an obvious influence on children? Evidence is contradictory, but the commercial is "presented within a backdrop of basic patterns of social relations and social reality--'how it is in the world'--that are repeatedly reinforced" (Riffe, et al., 1989).

Greenfield (1984) points out that children learn from commercials, remembering slogans, jingles, and brand names. Many studies have examined sex role stereotypes in television programming and the evidence is overwhelming that television shows a white male world (Barcus, 1981; Comstock, Chaffee, Katzman, McCombs, & Roberts, 1978; Greenfield, 1984; Riffe, et al., 1989). Others have examined the effect this world view may have on young viewers and have concluded that children who are heavy television viewers have more stereotyped views of sex roles than light viewers, tend to predict stereotypical adult jobs for themselves, and give more stereotypical answers to questions (Greenfield, 1984; Gunter & McAleer, 1990; Signorielli, 1989).

Men or boys appear in the vast majority of children's commercials and voiceovers (Barcus, 1981; Comstock, et al., 1978). Women are usually speaking to someone in a subordinate position, such as pets and children (Lovdal, 1989). Girls in children's commercials are most likely in food, doll, and game ads, while boys are in food, game, technology (computer games, hand-held electronic games), and "action" products. Commercials for boys' products use more action, frequent cuts, sound effects, and are located outside, while girls' ads contain more fades, dissolves, background music, and take place indoors, often in a bedroom (Comstock, et al., 1978; Greenfield, 1984).

COMPARISON OF NONPROGRAM SPOTS DURING CHILDREN'S PROGRAMMING

An informal analysis was conducted of children's television commercials on three networks in order to examine the number of commercials and differences in use of males and females. The author examined three four-hour segments taped from 7 a.m. to 11 a.m. on CBS (Saturday, November 16, 1991), ABC (Saturday, November 23, 1991), and Nickelodeon (Friday, November 22, 1991). The time was divided into program time (regular programming) and nonprogram time. The nonprogram spots were categorized as commercials (toys, food, restaurants, movies), buffers (divisions between program and non-program time), promos (station identification, program promotions), PSAs (public service announcements), and other miscellaneous spots.

Some interesting comparisons appear between the networks when looking at differences in nonprogram time and number of nonprogram spots. As shown in Figure 1, ABC had the greatest amount of nonprogram time and Nickelodeon the least. However, when looking at the number of overall nonprogram spots, CBS has the highest number. This indicates a greater number of shorter spots (15 seconds) than ABC (see Figure 2).

The breakdown by spot type (commercials, promos, buffers, PSAs, and other) reveals that all three networks have most of their nonprogram spots unsur-

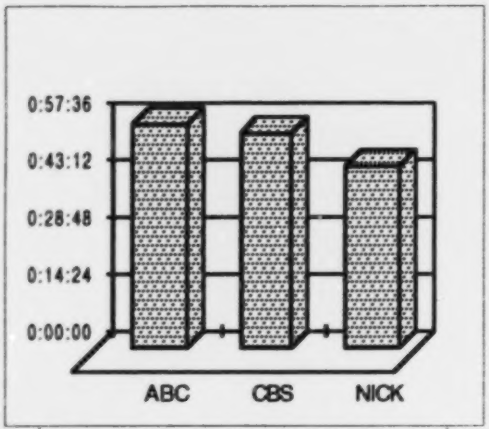

Figure 1: Nonprogram Time
(in 4 hours programming)

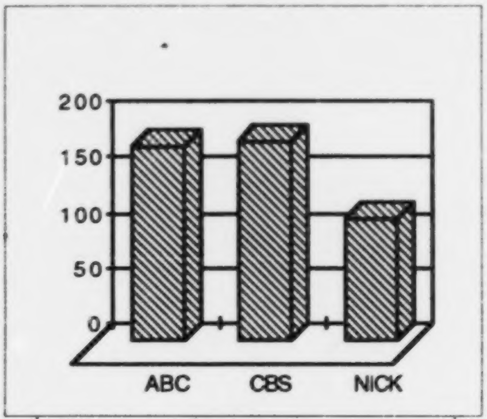

Figure 2: Nonprogram Spots

prisingly devoted to commercials (ABC, 77.8%; CBS, 79.9%; Nickelodeon, 47.5%).

It is when analyzing the use of male or female actors, spokespersons, and voice-overs that great differences appear. By far the greatest number of spots used men and boys (see Figure 3). Almost 81% of the spots used male voices. In addition, virtually no female voices were used for promos, buffers, and PSAs (each was 99.7% male.)

An examination of the 30% of commercial advertising utilizing female actors or voices shows that these commercials were almost exclusively for dolls, doll accessories and stuffed animals. All the commercials for "boys'" toys and restaurants used males. All the games, even those played by both girls and boys, used male voices for singing and/or narration (see Table 1). Lovdal (1989) writes that "male voice-overs continue to resound an authoritative tone and give the idea that men are more convincing, credible, and knowledgeable" (pp. 720-721).

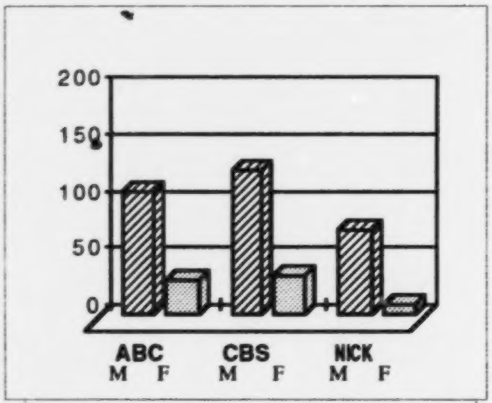

Figure 3: Male & Female Spots

COMMERCIAL LITERACY FOR STUDENTS

The remainder of this article describes a Commercial Literacy unit for fourth grade students. This unit initially was designed to be taught as part of the art program, with some integration into language arts, but grew and is now part of a cross-curriculum project involving language arts, social studies, science, math, and art, team-taught by four teachers. The purpose of this unit is to teach students to critically analyze commercials.

Project Risky Business

The Commercial Literacy unit is taught as part of a larger unit on the Northeast and corporations, called Project Risky Business. The four teachers (three fourth grade teachers and the art teacher) are the

Table 1: Types of Commercials and Use of Males & Females

	ABC		CBS		NICK		Total	
Type of Commercial	M	F	M	F	M	F	M	F
Action Figures	3		1		3		7	0
Toy Vehicles	2				3		5	0
Video Games	1		3		3		7	0
Dolls	2	15	2	17	4	5	8	37
Doll Accessories				8		3	0	11
Board Games	1		3		9	1	13	1
Stuffed Animals	1	6	3	3	2		6	9
Restaurants	10		5				15	0
Movies	10		4		5		19	0
Beverages	3		3				6	0
Cereal	17		14		2		33	0
Food	12		2				14	0
Misc.	2	7	8	5	6		16	12
Total	62	28	50	33	37	9	149	70

"parent company" and groups of students form subsidiaries of the El Cheap-O Toy Company. Each cooperative group of three to four students forms their own Board of Directors and makes up a company name and logo. A guest speaker talks about stocks, the Chicago Board of Trade and Wall Street. The groups then sell stock in their companies for twenty-five cents a share.

Each company now designs and makes a product, in this case a toy made from reused and/or recycled items. After learning about commercials and advertising they plan their own commercial, storyboard it, and videotape it. The commercials are shown to second and third grade classes who then come to "Kiddy Corp Day" and buy the toy(s) of their choice. The companies survey their customers to find out how large a part their advertising played in attracting buyers. After paying dividends to their stockholders they donate the remaining profits to charity.

Introduction to Advertising

Initial Discussion. The first part of the Commercial Literacy unit consists of informal discussion of advertising. Students discuss the purposes of advertising and where it is found (print, radio, television, billboards, etc.). The class then focuses on television commercials. Students talk about what commercials are, and how they are different from other types of advertising. They discuss favorite and least favorite commercials and what it is about them that stands out. A number of questions are asked, including:

- What is a commercial?
- What is the purpose of commercials?
- Why do we have commercials?
- What things do advertisers do to make their product appealing in commercials?
- What things do you enjoy about commercials?
- What things don't you like about commercials?

Commercial Selling Techniques. After discussing some general aspects of television commercials the students learn about some of the techniques advertisers use to sell their products. One of the most important things students must learn is that commercials are persuasive. They usually do not present the facts objectively and let the viewer decide, but rather persuade the viewer to use their product through a variety of techniques. Advertisers are trying to sell a taste, belief, goal, lifestyle, opinion, choice, or behavior. They try to convince the viewer that he or she has a need and this need will only be satisfied by their product. Their approach may be an appeal to the viewer's rational side, using "scientific" tests, survey results, or demonstrations to "prove" that their product is the best. Another approach is the emotional appeal, either verbal and/or visual, with little objective information.

Categories of Commercials. The next discussion centers on how commercials can be categorized, using some of the categories listed earlier. One category is the *testimonial* or endorsement, where some well-known figure touts the virtues of the product. Another could be called *image advertising* where the advertiser' is selling a lifestyle that people will want. Use of this product is seen as congruent with a certain image. A third category, *plain folks*, shows people that could be neighbors using the product. This enables the viewer to identify with someone just like him/herself. One example of this is any commercial using a hidden camera to film shoppers at a store. Another type of commercial, *bandwagoning*, urges viewers to join the crowd. If the viewer doesn't use this product they're missing out on all the "fun."

There are many ways commercials can be categorized and most commercials fit into more than one category, but this helps students to look more closely at what the message and technique are in a particular commercial. They also discuss what types of commercials work best with different products and target groups (for example, themselves).

Language. The teacher then discusses the use of language in the commercial. Exaggeration, enthusiasm, repetition, and assertions are all explained. The concept of "weasels" is introduced. A weasel is a technique, verbal or visual, that makes the viewer think they heard or saw something they didn't. A common weasel in toy commercials is showing the toy with all of the accessories. At the end of the commercial there is a disclaimer, usually very quick, that "accessories are sold separately," but most children don't notice that.

Technical Background. Next the students learn some of the technical aspects of commercials and video in general. The concepts presented are:

Lighting. Is the light bright or soft? Are some things more brightly lit? How are shadows used? Is the commercial filmed in outdoor or indoor lighting?

Color. Are the colors vivid or pastel? Does one color seem to predominate? What color is the product in comparison to its surroundings?

Sound. Is the sound loud or soft? Are people talking? Is music used in the background or as the main vehicle of the message? Are there sound effects? Is there a voice-over or narrator?

Pace. What is the pace or speed of the commercial? What does the advertiser do to give the feeling of speed/slowness? Does it go along with the type of product being advertised?

Camera angles and effects. Are we right in the action or looking at it from a different angle (down or up)? Are there many closeups? Do you get a feeling of distance or is everything pretty close to us? Are there any camera tricks to make objects look as though they change or disappear?

Transitions. Are there many different shots or only a few? What is the transition between shots--cut, fade, or dissolve?

Animation. Is animation used? Is it the main portion of the com-mercial or an add-on?

Other terms covered deal with camera movement (pan, tilt, zoom, dolly), distance (extreme close-up, close-up, medium shot, etc.), and composition (background, props, lighting).

Analyzing Commercials

The students are now ready to put into practice the information they have learned. They watch two or three toy commercials and critique them as a class, following guidelines on a worksheet. The commercial is replayed with no sound to help them focus on the visual aspects. Additional questions are: Is the commercial as effective without the sound? How does the lack of sound change the commercial?

The remaining discussion centers on the less obvious and tangible messages the commercial presents. Are there any implicit promises ("You'll be more popular with this product!")? What view of reality is presented (all children who use this product are happy, well-dressed, etc.)? Who has the leading role in this commercial? Is the commercial aimed at boys, girls, or both? Are there any differences in how the boys and girls are presented? Why? Is this the way things really are? What other messages does this commercial send?

Students then work in their groups analyzing two commercials. They also have homework in that each student must complete an individual commercial evaluation as well.

Planning and Making Commercials

The students now have a foundation of knowledge about commercials and their technical and persuasive aspects. The next activity centers on planning and producing their own commercial for their company's toy. The groups plan their commercial first, deciding on their approach and overall theme. They then write a thirty second script, including descriptions of any action that will be taking place. While writing the script, they emphasize persuasion, repetition, and enthusiasm.

Now that the initial planning is finished, the students are ready to storyboard their commercials. Each group receives storyboard forms and makes a rough sketch of each shot with accompanying script and camera instructions. Once the storyboards are approved the groups are ready to videotape (done by the art teacher).

Evaluation

The final activity of the Commercial Literacy unit is a large group discussion and analysis of each small groups's commercial. The students use the same format for critiquing as they did for the professional commercials.

CONCLUSION

This brief examination of commercials shows very clearly that they do not reflect reality in any way. Unless children are taught to view television critically and **literately**, they will simply be passive recipients of its messages.

Many researchers have shown that children do not have the skills to view commercials appropriately, but that is in part due to the lack of instruction in critical thinking skills (Allen, Wright, & Laminack, 1988). By teaching children who are at the developmental level appropriate for such cognitive skills how to suspend their belief we can set the foundation for them to become more educated, visually literate consumers of television.

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Visual Design in the Planetarium

by
Jeffrey L. Hunt

Introduction

The planetarium is a visually sophisticated arena. A star projector alone projects thousands of stars on the domed ceiling to simulate the night sky. Supplementary projectors present slides and special effects like meteor showers, rotating galaxies, swarming star clusters, and other dynamic events. Other domed theaters have all-sky film projects, while video projectors show laser disc, video, and special effects. A recent addition to the domed theater is a computer projection system. A high-intensity CRT projects a star map on the ceiling. Besides projecting a starfield, the moon, sun, planets, this new system creates animation of moving stars, orbiting satellites, and the rotating galaxy. Planetarians have attempted to accommodate the handicapped patron (Bouslog & Parker, 1983), but the experience primarily remains an audiovisual experience. As time goes on more sophisticated media are being introduced into the domed theater.

Planetarians, as a group, appear to be visually sophisticated, as many can identify all the objects in a photographic Messier catalog without delay. The Messier catalog is a list of 110 diffuse objects, compiled by Frenchman Charles Messier in the late 18th century, that astronomers should not confuse with comets. Mallas and Kreimer (1978) compiled a photographic atlas of the diffuse objects. Amateur astronomers target their telescopes on the Messier objects. Go to any telescope star party and at least one or two objects will be trained on an "M" object.

Many planetarians conduct telescope viewing nights at their facilities and at parks and campgrounds. To see the fuzzy Messier objects, an observer must have sharp, averted vision. Planetarians can see those faint, nebulous objects through their telescopes that even the most frequent planetarium visitor cannot discern. Their museum galleries, slide libraries, and office walls are filled with marvelous color photographs of the visual universe beyond. Daily they see hundreds or even thousands of images of celestial objects as they present shows to their patrons and design new ones. Planetarium visitors are not necessarily visually sophisticated. Most probably cannot tell the difference between planets.

When presented with a photograph of Messier 1 (Crab Nebula), many planetarians can identify it by name, describe it as the remnant of the supernova of 1054 A.D., and may be able to identify the location of the pulsar -- a dense, rotating stellar corpse, at its heart. The planetarium visitor would probably identify M1 as little more than a smudge of light. S/he does not have the repertoire of visual experiences of most planetarians. Because of the vast gulf of visual experiences, planetarians drive visual Ferraris and most of their visitors clunk along in visual Yugos. Planetarians must accommodate this apparent gap in visualization performance.

This writer's comprehension comes from many years of experience working with groups of all ages. Planetarium patrons appear to be visually unsophisticated. When children react in a positive fashion when seeing a beautiful color photograph of Saturn, to what are they reacting? The color of Saturn's clouds? The size of the image? The shape of the planet? .The color and texture of the ring system? There is no research to explain their reactions.

This author includes some participation and questions with appropriate wait times, but until recently, this author based his feature presentations and lessons on intuition, experience, and personal preference without much regard for research. Riordan (1991) reviewed the various planetarium research projects ranging from classroom versus planetarium lessons, participatory lessons, and focused research.

The intent of this article is to review learning research of visuals and media from education, summarize it, and extrapolate this foundation into the planetarium. Certainly, extending any research is a dangerous maneuver, but this author will propose research projects that planetarians can perform in their own theaters. He hopes these ideas will facilitate discussions among his peers, additional articles from interested writers, and research projects to test these proposals. With thousands of data points passing through their domes each year, all planetarians can help construct a framework of understanding on the use of effective visuals and media in the planetarium.

Visual Literacy Research

Dwyer (1978, 1987) has devoted many years to researching the effectiveness of diagrams of the human heart. His study of visual literacy may have direct meaning and application in the planetarium. In his long-running project known as the Program of Systematic Evaluation (PSE), he has evaluated over 35,000 high school and college student subjects with his heart diagrams and a 2,000-word script (Dwyer, 1987). He uses sets of eight types of diagrams to test his hypotheses. They vary in complexity: simple black and white line drawings; simple color line drawings; detailed black and white shaded drawings; detailed color shaded drawings; black and white photos of a heart model; color photos of a heart model; black and white photos of a real heart; and color photos of a real heart.

He developed eight mediated sequences of 37 slides each and one presentation with no graphics based on the same learning objectives. Some of the variables he studied:

1. Method of presentation (television, slide tape, selfpaced).
2. Effect of amounts of detail in images.
3. Color versus black and white.
4. Cueing techniques (arrows, animation).

After the treatment subjects participated in five tests: terminology, identification, drawing, comprehension, and total criterion (Dwyer, 1978).

In testing method of presentation, Dwyer found that programmed instruction (self-paced) dominated as the best with nearly every set of heart diagrams. He concluded that this method was more effective because the subjects had more time to interact with the visuals than in the externally paced (television and slide/tape) treatments. In astronomy education research, McLellan (1987) showed the importance of self-pacing and interactivity with a microcomputer and software called *Sky Travel.* Since the planetarium is not a self-paced environment and hardly interactive—especially for students having complete control as they would with a computer—planetarians need to look at ways to increase learning to approach self-paced achievement.

Dwyer (1978) demonstrated that time is a factor. In the slide/tape version, the presentation was 40 minutes in length. When the same presentation was delivered on television, for only 17 minutes, the slide/tape version was superior. This is not good news for the planetarian who uses hundreds of slides in a one-hour feature presentation. When visitors are shown too many slides, too fast, they don't remember what they saw. He stated, "[W]hen it is found that visualization used to complement instruction does not improve achievement it may be a worthwhile strategy to increase the amount of time students are permitted to interact with the instructional unit" (p.71). Specifically, show fewer visuals and show them longer.

In the slide/tape mode, Dwyer discovered that simple black and white line drawings were better than realistic photographs. In this externally-paced mode, there may be too much information in a realistic photograph for a learner to look for the desired information. Edit out the unimportant information by offering a line drawing or a simplified photograph. the type of diagram is determined by the type of objective.

In a study performed with realistic photographs, Berry (1991) found that realistic color photographs were more effective than black and white or non-realistic color photos. In his study, he showed his test subjects a slide for 20 seconds. Then the subjects were allowed four minutes to write down everything they saw, and they remembered more when they viewed the color photographs. After a five-minute *rest period,* the process was repeated. Subjects were exposed only to three photographs. This study does not conflict with Dwyer's work, but possibly can be applied to the planetarium exhibit galleries. Single color images at slow pace with ample *rest time* are better than black and white and false color photos.

Cueing Techniques

A cue is a technique to attract attention to important details in a visual. "For a student to learn optimally from a visualized presentation, he must be able to locate, attend to and interact with the relevant instructional stimuli ""(Dwyer, 1978). Various methods of assisting (cueing) the learner to interact with a visual can be employed. He listed nearly thirty techniques, including arrows, lines, labeling, size, animation, encircling, bordering, color, and advance organizers.

Cueing is a common technique in the planetarium; the console pointer is the most common. Planetarians cannot imagine showing starfields, describing the color and position of individual stars without designating their places with their pointers. Another type of cue is telling the planetarium visitor where to look. "If you look to the west, just after sunset, you'll find brilliant Venus." Cueing a learner with other visuals is just as important.

From informal discussions, this author learned that many planetarians do not use cueing as part of their shows. They feel that arrows and labels (words) destroy the mood that the planetarium environment creates and the illusion of infinite size of space. Planetarians would not be without their console pointer to designate (cue) stars, constellations, planets, and deep sky objects. The pointer demonstrates that the night sky created in the domed theater is an audiovisual illusion because it designates the position of the projection screen.

Futhermore, slides and other effects reveal the surface of the dome, show the perferations, and seams on the structure. With the illusion already modified by the use of the pointer and other audio visual effects, why not use cueing with other visuals to assist in learner retention, if cueing is demonstrated to be effective.

Animation (motion) is another cue that Dwyer suggests. Several studies have been performed by various researchers using a microcomputer. Many planetariums shows are computer-controlled so planetarians should take note of this research. Computer control of a planetarium show and computer-based instruction insure that the message is delivered the same each time.

In a review article, Rieber (1991) looked at the years of research involving animation. His review showed there was little research on animation, and the research that had been accomplished, at the time, showed that "animation is not a powerful influencer on learning." Furthermore he stated, "when learners are novices in a content area, they may not know how to attend to relevant cues or details provided by animation."

Rieber (1989a, 1989b, 1990) made important contributions to the study of animation with computers and Newton's laws of motion. His research showed that animation may be useful for some age groups but not others, and that his subjects learned better when they knew the content they needed to look for in the animated sequence. When his animated sequence was used with elementary students (fourth graders), the animation yielded better learning when students had further practice. He concluded that animated graphics may be significant, but that experiment did not show it. When the sequence was used with a group of college students, animation had no effect. Students benefitted more from the review than the treatment. Perhaps this was academic acculturation of learning that caused students to want a review so they knew "what to study for the test."

Gary Mayton (1991) attempted to put Dwyer's PSE into a computer based instruction module. He created still frames and animation with screen text. Although his work was incomplete, it yielded slightly better learning for animated graphics.

Is animation significant in the planetarium? Is the expense of video projectors and motion picture projectors justified in learning gains? Research does not, yet, supply the answer.

Dwyer (1978 and 1987) showed that color was an important cue in his simple line drawings and the fewer the color cues, the better. Start (1989) showed that color was significant, but since he tested the colors of an abstract shape it would be unwise to extend his research to learning in a regular classroom or the planetarium. Is color effective as a cueing agent in the planetarium? If so, how should color be used? Research offers no answer.

In significant cueing research (advance organizers) for the planetarium, Walter Bissard (1979) studied four treatments of introducing terminology of *The Last Question* with public program audiences. In his treatment he introduced energy terms used in the show by subjecting visitors at Abrams Planetarium at East Lansing, Michigan, to a slidetape introduction, a written text introduction, a live introduction or a null (no) introduction. He found that subjects learned more about the contents of the show with an introduction than subjects who had none, and that a slide-tape version, when properly designed, appeared best. Furthermore, he showed that different programs should be used for different audience demographics in public shows, especially when different show times can be demographically identified. This cueing medium should be offered to all public program groups for taped programs. The research appears clear on this point.

Is Bissard's work the extent of cueing that is appropriate in the domed theater? Are there other ways to enhance learning? Again, research does not supply an answer.

Audiovisual Research

Like other media research testing the effectiveness of one form against the learning gain from another, the comparative media versus planetarium test reviewed by Riordon (1987) were inconclusive. This is in agreement with other research summarized by Schramm (1977), in that Schramm reviews that no single medium is better than any other. According to this conclusion, learning in the planetarium will never be consistently better than the same principle demonstrated with a chalkboard or overhead projector. The planetarian should not be disheartened with the effectiveness of the planetarium. Schramm contends that multiple media are necessary to teach concepts. For example, a teacher may be conducting a unit about constellations. At school students read stories, and conduct their own library reports about various constellations. The students attend a lesson at the planetarium about the constellations and their mythology. Students are encouraged to attend a nighttime viewing of the sky held at a park on the weekend. After the planetarium visit, students are asked to create a poster to demonstrate their learning about the constellations. This multiple approach will help the student learn, better than just a single, one-time planetarium experience.

Multiscreen static image is a popular form of image presentation in the planetarium. Several studies Fradkin (1974), Brydon (1974), and Jodoin (1976) provide mixed results, but tend to show that multiscreen is at least as effective as a single screen image. This pattern of presentation in the planetarium needs some study, especially in light of the possible increase in effectiveness of visuals by using cues.

Facility Goals and Objectives

How visuals are used in the planetarium depends on the facility's goals, mission, and objectives. Distinguished correspondents to a discussion question in the "Forum" column of the December 1991 issue of *The Planetarian* seemed to agree that their planetariums serve as a resource of astronomy information—education: where to find selected objects in the night sky, teacher workshops, astronomy shows, etc. If education is the planetarium's primary mission, shows should reflect this goal.

William Peters of the Alberta Science Centre of Calgary, Alberta, Canada, hoped for more technology: "Install Digistars, Omimaxes, Cinema 360s, fish eye slides, big screen video. go for the big picture." Is a multimedia blitz compatible with an institution that is "gloriously alone in its basic role" -- the topic of discussion—or is it a contradiction? There is no research in the planetarium field to suggest big screen improves instruction. Every planetarian has an opinion based on experience and intuition. Actually, Dwyer's (1978) research showed that an increased size of the heart image did not improve its effectiveness.

To be fair to Mr. Peters, large images are fun, exciting, interesting, and entertaining; perhaps they increase the aesthetic value of the planetarium experience. Large scale projection may increase attendance and revenues, but the visually literate planetarian must put a turbocharger on the visual Yugo to make the technology-driven planetarium show "educational."

For many years an informal topic of discussion centered on the question, "What if you gave a planetarium show and nobody attended?" The question has a corollary: "What if you gave a planetarium show and nobody understood?"

This author (Hunt, 1991) entered the debate of the role of the planetarium from a management perspective. His statements were intended to give perspective of what planetarians do in their domes. Largely, the function of the local planetarium depends on the philosophy of the parent organization. The institutions range from formal education setting to those for entertainment only, but the correspondents from major planetariums across the globe responding to the "Forum" question insisted that their mission is education.

What plays in Chicago and New York will not necessarily fill the dome or fit the philosophy in Peoria. Certainly, there is a blend of entertainment and education in every facility. The mix depends on institutional goals and function. Feature shows need not be clones from facility to facility, but the same basic elements of a show should be similar, especially if they are based on research.

Because of the rate at which images are presented in a domed theater, every beautiful image in the planetarium's library may not be appropriate. Just because planetariums have sophisticated modern audiovisual technology does not mean that it should be used in every instance. Use the technology that fits the learners' needs and cognitive abilities, learning objectives, learning style, and the institutional goals.

Planetarians, as a group, do not give the visual element of the planetarium experience enough consideration and planning. Obviously, they recognize the visualized aspects of astronomy, but, perhaps, they do not plan the visualized messages as they design other elements of a planetarium show.

McColman (1990) reported on his evaluation of "good planetarium shows". In his writing, the soundtrack, musical content, and aesthetic quality were most important. Without them "all of the other elements are little more than a loose jumble of pretty pictures." This statement needs research.

The September 1991 issue of the profession's global publication, *The Planetarian*, had several regular feature sections, including" Mobile News Network, Opening the Dome, Gibbous Gazette, Planetechnica, Forum, Scriptorium, Regional Roundup, President's Message, Kodalith Corner, and Jane's Corner". There is no mention of the production or use of effective visuals in those feature columns or in the major articles.

The consideration of the aforementioned published work is not an indictment of Messrs. Peters or McColman, of John Mosley, *The Planetarian's* editor, or the planetarium community. It is a statement of how planetarians take for granted the visual aspect of the domed theater. Without visual elements planetarians might as well create audio tapes and send them to their patrons.

Proposed Research

A major intent of this article is to invite planetarians and those concerned with visual literacy research to test some of the ideas presented here. Following are ten proposed research questions for planetarians to consider. When using the same instructional objectives:

1) Do planetarium visitors learn more by showing fewer visuals and showing them longer?

2) Under which format do planetarium visitors learn best, simple black and white line drawings, color photographs or false color photos?

3) Are cues such as labels (words), color coding of line drawings, arrows, and lines or visuals without cues significant to learning in the planetarium?

4) Is animation significant for the learning of the planetarium visitor? If animation is significant, does it need cues?

5) Is animation better than a dissolve sequence showing the same dynamic process? If dissolve sequences are more significant, do they need cues?

6) McColman's statement (music, soundtrack, and aesthetics are most important) should be tested. Planetarians can create a show in the regular fashion with music, sound effects, and spoken script. Compare the learning in a *regular* show with one that has music and sound effects in its soundtrack and cued visuals and small amounts of text projected on the dome. Use a regular show without visuals. This writer believes many patrons will reject the second type of *show* on cultural purposes. They expect to hear a voice in the planetarium experience and

not see photographs with words. They may accept the third type, without visuals, but they probably expect visuals with their shows.

7) In an all-sky movie (Omnimax, Cinema 360, etc.) experience, do visitors learn more if visual cues are projected with slide projectors over the movie to distinguish important points in the soundtrack or without cues?

8) Does the image size make a significant difference in learning in the planetarium?

9) Do multiple images in a multiscreen format compared to a single screen affect learning in the planetarium?

10) How do these factors work with visitors of various Piagetian frames of reference?

Summary

Before the planetarium becomes too technological, planetarians should consider the appropriateness of the technology with the goals and mission of the institution. When sophisticated audiovisual technology is used, the planetarian must help the planetarium visitor make the technological step by giving the visual Yugo a boost.

Bissard showed that visitors can learn more if they are told about the important terms and concepts in a show by showing a short, well-designed slide-tape presentation before the show. Researchers from educational fields have shown ways to increase learning through well-designed visuals. Further research directed in the planetarium will expand our knowledge of how the planetarium patrons learn.

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Problems in Picturing Text

by
Philippa Jane Benson

BACKGROUND TO THE TEXT/ILLUSTRATION STUDY

Over the past quarter century, communication technologies have spawned an explosion of possible ways in which linguistic (i.e., text) and non-linguistic (i.e., visual displays/ illustrations) information can be combined for different purposes (McLuhan, 1964; Goody, 1987). In our daily lives, we encounter a myriad of mixed visual and verbal messages: illustrated textbooks, icon-laden computer interfaces, print and television advertising, and instructional manuals. At the same time, the large-scale reproduction and distribution of visual and verbal patterns has strongly influenced the degree to which these patterns can and are becoming social conventions (Ong, 1982; Kostelnick, 1990).

As information is increasingly transmitted via combinations of linguistic and non-linguistic forms, a topic of concern is the development of well-integrated visual and verbal representations of information. To date, studies have looked at issues related to but not directly addressing this topic. For example, extensive research has been done on the cognitive processes used by both experts and novices as they create and revise text (Hayes & Flower, 1980; Graves, 1985; Bereiter & Scardamalia, 1987; Hayes et al., 1987). In a similar vein, other researchers have focused on the process of design and of designers (Broadbent, 1979; Buchanan, 1985; Ballay, 1987; Kostelnick, 1989). Still others have investigated the relationship between the presentation of visual and verbal information and reader comprehension (Schallert, 1980; Bluth, 1981; Hayes & Readence, 1983; Abel & Kulhavy, 1986; Larkin & Simon, 1987; Levin, Anglin, & Carney, 1987), while yet others have looked at the relative comprehensibility of different kinds of illustrations (Peeck & Goud, 1980; Szlichcinski, 1980; Levie, 1987; Reynonds & Baker, 1987).

Little research, however, has directly explored the processes people use or the rhetorical constraints people consider when integrating visual and verbal representations of the same information. Rhetorical constraints could include consideration of the intended readers of and purposes for the integrated information, of others preparing the information, or of those who will use the information to inform, instruct, or persuade.

Bearing in mind the wide use of combined visual and verbal information in modern society, research in this area is a significant next step to take in rhetorical studies. First, by uncovering and understanding more about the processes people use to diagnose and address problems in integrated visual and verbal forms, we can understand more about the specific roles rhetorical constraints play in the development and interpretation of visual/verbal combinations. Second, such studies will allow us to more fully understand interactions in visual and verbal problem-solving. Finally, these kinds of studies may help us move toward a richer notion of "literacy," one that includes facility in comprehending and producing integrated visual and verbal forms.

AN OVERVIEW OF THE TEXT/ILLUSTRATION STUDY

The participants

To explore and characterize the problem-solving processes of experts evaluating and revising text/illustration combinations, I conducted a study using experts from three different fields. The participants were asked to diagnose and address problems in mismatched visual and verbal information in text/illustration combinations. The study included five subject matter experts [biologists] (SME), five professional designers (D), and five editors (E). These experts were selected because all had high levels of expertise in their respective areas, had been working in their fields for between five and twenty years, and had experience collaborating with others in the development, production, and/or evaluation of illustrated instructional texts. In addition, all the subject matter experts (henceforth SMEs), three of the editors, and four of the designers were either currently teaching or had previous teaching experience.

The text/illustration combinations

For the purposes of this study, text/illustrations combinations from textbooks were chosen to represent combinations of visual and verbal representations of the same information. Fixed print combinations of text and illustration were chosen for several reasons. First, they are the kinds of text/ illustration combinations that are pervasive in instructional materials and are known to be as often confusing as clarifying for readers (Pressley et al., 1983). Second, a strong base for this study is provided by previous research on reader comprehension of print text/illustration combinations which suggests that well-matched texts and illustrations can aide learning (Willows & Houghton, 1987). The topics of the text/illustration combinations chosen for the study were

1) the life cycle of a species of fern,
2) the life cycle of a kind of fungus, and
3) the movement of glaciers during the ice age (see Figure 1).

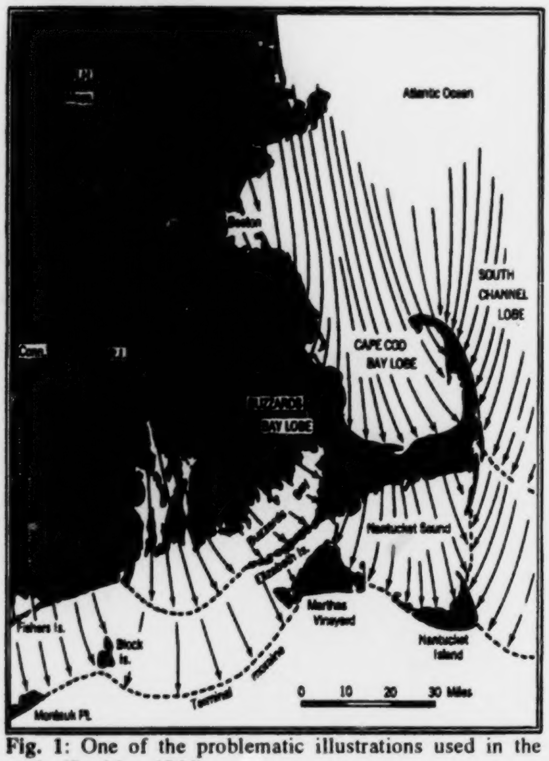

Fig. 1: One of the problematic illustrations used in the study (Strahler, 1966).

These three particular combinations were chosen because they

- came from widely-used instructional texts and focused on topics that virtually every high school science student will encounter: the ice age, and life cycles of two different life forms, molds and fungi.
- contained visual and verbal information mismatched in ways typical of text/ illustrations combinations found in instructional texts. Mismatched information could include, for example, information that is topically prominent in a text but is not in the illustration, or objects or processes highlighted in the illustration but that are not mentioned in text. A variety of mismatched or missing information was present in all three text/illustration combinations in the study.
- can be considered different by type (Levin, Anglin, & Carey, 1987): one is representational, reinforcing major events described in the text; another is organizational, representing the organizational framework of the text; the

third interpretational, using non-exact pictorial analogies to make abstract concepts in the text more concrete and accessible.

These different kinds of illustrations were included in the study to obtain a fairly broad representation of types of problematic text/illustration combinations and thus avoid narrow conclusions, including the potential problem of uncovering expert problem-solving strategies that might be associated only with one type of illustration or one category of mismatched information.

The design of the study

Each expert was given three different problematic text/illustration combinations to revise, for a total of forty five revision sessions (see Figure 2). Participants were presented with the combinations in counterbalanced order within groups to avoid both learning and fatigue effects in the final data.

	SME	Designer	Editor
Fern	5	5	5
Fungus	5	5	5
Ice	5	5	5

Fig. 2: Each participant revised three text/illustration combinations.

In addition to the expert participants, fourteen first year university students read and interpreted the text/illustration combinations. Space limitations precludes this part of the study being discussed in detail in this paper.

COLLECTING THE DATA

Experts' revision task

Concerted efforts were made in the design of this study to create a task that was not artificial; according to pilot studies and preliminary conversations with the participants, the task of individually reviewing text/illustration combinations (ones created by others) was a realistic task for them. In fact, most participants said that although illustrated texts were sometimes reviewed or refined by collaborative teams, the task of individually reviewing text/illustration combinations was a familiar one, one they considered part of their professional work. However, to underscore the collaborative nature of the textbook publication process, the instructions reminded participants that others involved in the publication of the final book would be reviewing their work.

The task instructions asked participants to revise each text/illustration combination to improve the match between the text and illustration in a way they felt would make the information easier for a tenth grade reader to understand. The instructions stated that participants could make any revisions they wanted and informed these experts that their draft revisions would be given to other revisors as a model of an effective text/illustration combination. Participants were allowed to spend as much time as they wished to complete each task.

Data collection

Before beginning the actual revision tasks, each of the fifteen experts was allowed to practice thinking aloud while working. After the practice sessions, they were given their task instructions, the text/illustration combinations, and sheets of blank paper and colored pens to use in making revisions. Experts were tape recorded as they thought out loud while revising the text/illustration combination/s. (Each transcribed problem-solving session is referred to as a *protocol* and the process of examining them *protocol analysis* [Newell & Simon, 1972]). Some experts revised the text and/or illustration on the original materials, while others used the blank sheets to write or sketch complete new material. Experts took between twenty minutes to over two hours to complete each revision task. Most experts spent about an hour revising each combination.

CODING THE DATA

Preparation of protocols

The tapes of the expert revision sessions were transcribed and typographically marked to indicate when a speaker was either reading, rereading, writing, or drawing (boldface indicated reading, underline signalled rereading, italics was writing or drawing, plain type indicated commentary). If subjects were drawing, the drawing's location was indicated in parenthetical notes in the transcripts. Together these materials provided a record of how participants interpreted both the text and the illustration in each combination, as well as how they detected, diagnosed, and/or addressed different kinds of visual or verbal problems.

The transcripts of the protocol sessions were segmented into episodes, ranging from a few words to lengthy narratives, which were checked and agreed upon by two coders. Similar to the motivation of Newell and Simon (1972), the purpose of separating the protocols into episodes was "to focus attention on the features of behavior that are most relevant to assessing a subject's problem solving abilities" (p. 284). Coders judged episode boundaries to be where subjects changed their focus of attention from one activity to another according to the coding scheme described below. If reading, rereading, writing, drawing were part of a larger activity, these sections were incorporated into the overriding episode in the transcript.

Coding scheme

The transcriptions were coded according to a coding scheme designed to capture general high level activities and to capture details of the experts activities as they work with the text/illustration combinations. Figure 3 shows the fourteen specific codes associated with the four primary coding categories of meta-codes, co-codes, text codes, and design/illustration codes.

General comments not directly related to the task (such as "This is tiring!") as well as comments related to planning or consideration of task were marked as meta-comments (C, Proc, Task). The audience or match co-code (Aud, M), along with either a text or illustration code, marked comments that included consideration of audience or that indicated the expert was trying to match information between the text and illustration. When participants were focusing on the text, their comments were marked with one of the five text codes (TC,TI,TL,TD,TS) and when they were focusing on the illustration, their comments were marked with a design/ illustration code (DI, DL, DD, DS).

Text/illustration codes

Meta-codes	
C	Catch all, for meta-comments
Proc	Planning or accounting of process
Task	Consideration of task
Co-codes	
Aud	Consideration of audience
M	Indicate matching of information between text and illustration
Text codes	
TC	Context of material
TI	Interpreting meaning of text
TL	Detecting and/or Diagnosing problem based in text language
TD	Detecting and/or Diagnosing problem based in design of text
TS	Planning, executing, or revising solution for text-based problem
Design/Illustration codes	
DI	Interpreting meaning of illustration
DL	Detecting and/or diagnosing problem based in language in illustration
DD	Detecting and/or diagnosing problem based in design of illustration
DS	Planning, executing, or revising solution to illustration-based problem

Fig. 3: The coding scheme used for the study.

This coding scheme is based on the idea that every text/illustration combination has both linguistic and non-linguistic components. For the purposes of this study, "non-linguistic" information refers to graphic elements of visual displays including illustrations, typography, and page layout. Here, "linguistic" information refers to text as written discourse. In this context, text refers to printed English language and illustration refers to drawings that accompany texts. However, a text can include non-linguistic features such as variations of typographic cues (e.g., use of boldface or italic type styles) and an illustration can include text features such as labels. Therefore, as illustrated in Figure 4, the texts and illustrations in this study both have visual and verbal components. In the coding scheme, both the text and the design codes consider verbal and visual information.

	Text	Illustration
Visual	*Design of Text*	*Design of Illustration*
Verbal	*Language of Text*	*Language in Illustration*

Fig. 4: The texts and illustrations used in this study have both visual and verbal components.

ANALYZING THE DATA

I conducted three analyses on the data collected from the protocols of the experts as they revised the text/illustration combinations. One of analysis used counts from the main categories of the coding scheme to look for relationships among how much individuals said, the revision task they were doing (e.g., which t/i combination), and the group they belonged to (e.g. designer, editor, SME).

The second analysis looked at data reflecting the extent and manner in which subjects considered audience (both students and collaborators) as they did their revision work. Data reflecting the problems experts found in the text/illustration combinations was also analyzed.

Log-linear models

To analyze the data concerning the strategies of different experts, log-linear analyses were used to model the data from the main coding scheme. I used log-linear models rather than more traditional (e.g. ANOVA) analytical methods first because the study was exploratory and, therefore, not designed to test any particular hypotheses and, second, because the data was categorical. Log-linear analyses are designed to test, or attempt to "fit," statistical models to categorical data, with each model representing a different description of relationships between categorical variables. Statistical methods used in log-linear modeling are also appropriate to use when one wants to look for possible interactions among variables. Thus, log-linear modeling promised to be useful in bringing to the fore relationships among the revising behavior of individual participants (as reflected by the coding scheme), the text/illustration combination being revised, and the group to which each individual belonged.

To explore possible relationships between the fifteen subjects, the three tasks (Fungus, Ice, Fern), and the subject by group (Designers, Editors, SMEs), log-linear models were constructed to compare how much was said about a problem (amount of commentary) and how subjects' comments were distributed among the meta, audience, text, and design codes (pattern of commentary). Taken together, models of individual's amount and pattern of commentary indicated that

- subjects and tasks jointly determine how much is said,
- how revising attention is allocated among the activities represented by the codes (meta, audience, text, and design) is determined only by the subject, and
- subjects themselves behave relatively consistently across tasks.

Another model explored the possible influence of expert group on the amount or pattern of commentary during revision. This model assumed that every subject within a group was like every other subject. The results indicated that a relationship existed between group and pattern of commentary, although it could not be seen at a very fine grain. In other words, given that subjects can vary within groups, grouping does have some effect on the pattern of responses, even though this analysis does not allow us to see that effect very clearly.

Considering group as a variable is valuable because it allows us to predict how other persons might behave based on which group they were in. In other words, we hope to find a measure of what makes Group A like Group A: designers like designers, editors like editors, subject experts like subject experts. Although the log-linear analyses suggested that the expert groups did cohere as groups, the results also indicated that much more subtlety needs to be included in any characterization of expert revision behavior.

The next two sections describe how the study accomplished the goal of describing the subjects' revisions at a more fine grain by looking at how experts considered audience and how they identified problems.

Expert's perception of audience

A second analyses looked at data from the coded protocols reflecting the extent and manner in which subjects considered students and collaborators as audiences for their revision work. Based on the previous analysis and in pursuit of more precise understandings of what makes individuals distinguishable by group, the analysis was designed to weed out differences in how each group considered audience as they revised.

As shown in Figure 5, across all tasks the fifteen participants made a total of 177 comments referring to audience groups. Audiences considered by the experts included students as well as other designers, editors or writers, SMEs and, in a few cases, teachers. Designers, editors, and SMEs differed in terms of **how many** comments concerning audience were made, **when** these comments were made, **who** was considered as primary audience, and **what kinds** of considerations of audience were given priority.

Group	# of comments
Designers	36
Editors	56
SMEs	85

Fig. 5: The number of comments each expert group made about audiences.

The most obvious difference between the groups is **how many** comments were made about audience: SMEs accounted for almost one half of the comments, while editors accounted for about one third and designers for only about one forth.

Designers, editors, and SMEs also differed in terms of **when** they considered audience. Specifically,

- Designers consider audience most when diagnosing problems in text and when developing solutions to problems in design,
- Both SMEs and editors consider audience most when diagnosing and developing solutions to text problems, and
- Unlike designers and editors, SMEs consider audience when considering the context of use of the materials being revised.

SMEs again differed markedly from designers and editors in terms of **who** they considered as their audience of primary concern. Specifically, they were much more concerned with students as readers of their revisions (87% of their comments on audience) than with peer collaborators (13%). On the other hand, designers and editors approximately split their attention approximately evenly between students and collaborators.

Some similarities between the three expert groups appear when looking at the data on audience in terms of **what kinds** of considerations of audiences were made. For example, both designers and SMEs made general reference to student readers in about 20% of their comments, e.g,

> "I don't know if the students will see that..."

and another 20% of their comments were concerned with how the material would affect the motivation of student readers, e.g.,

> "You wonder if a student is going to get all the way from the top through all of these words."

Editors considered students' motivation only half as often as the designers and SMEs. The remaining comments that both designers (60%) and SMEs (58%) made about students centered on concern for students' prior knowledge

> "I think for this to be studied I have to assume that students already know diploid and haploid and know some idea of what that means in general...".

Editors also distinguished themselves from designers and SMEs by giving somewhat less attention to how the materials would affect the motivation of student readers and by giving more attention to consideration of collaborators as audience. Specifically, in just over half their comments about collaborators, designers and SMEs made general comments not referring to any specific collaborative group (i.e., other designers, SMEs, editors, or teachers) while over 60% of editors' comments about collaborators were concerned with other editors or writers. In other words, as a group, editors appeared to focus on working with others on revising the text rather than on collaborating with others on design or on content.

In sum, the data indicates that consideration of audience during revision clearly distinguishes the three expert groups. The major findings showed that SMEs consider audience more often than do editors and designers, and that their revisions are guided more by considerations of end readers (in this case students) than by consideration of their collaborators. Unlike SMEs, editors revision strategies were more strongly affected by consideration of working on text with colleagues.

Expert's perceptions of problems

In a final analysis, data was compiled reflecting problems experts found in the text/illustrations combinations. To collect data on problems, comments reflecting experts' detection of problems were collected from all forty five transcripts. Problems were coded as falling into one of the four main coding categories, that is, problems with the text's language (TL), the design of the text (TD), the labels (e.g. language) in the illustration (DL), or the design of the illustration (DD). Problems were analyzed both in terms of the **how many** problems experts noticed and in terms of **what prompted** the expert to notice the problems.

The fifteen experts mentioned a total of 665 problems, as shown in Figure 6. Each problem was counted only once for each expert, regardless of how many times they mentioned it.

	Designers	SMEs	Editors
Text Language	99	126	131
Text Design	8	3	3
Design of Language	48	41	32
Illustration Design	81	47	46
	236	217	212

Fig. 6: Counts of problems experts found in each major code category.

Several differences among the groups can be seen from the raw counts. First, designers noticed approximately 20% fewer problems in the language of the text than did either SMEs or editors. On the other hand, designers noticed nearly 15% more problems in the design of illustrations than either SMEs or editors. Overall, however, despite moderate differences, the groups showed marked similarity, particularly the SMEs and the editors. First, each of the three groups accounted for approximately one third of the total number of problems detected, and the problems found in each category were in the same rank order for each group. In other words, in all three groups, experts detected the greatest number of problems in the language of the text, followed by problems in the design of the illustration, followed by problems in labelling problems, and problems in the design of the text. Third, all three groups detected more problems in single domain cells (e.g. verbal/verbal (TL), visual/visual (DD) than in mixed-domain cells (e.g., visual/verbal (TD), verbal/visual (DL)). Figure 7 illustrates single and mixed domain cells.

	Text	Illustration
Visual	TD	DD
Verbal	TL	DL

Fig. 7: The fully bordered TL and DD cells are single domain cells, TL concerned with information in only verbal (linguistic) form and DD concerned information in only visual (non-linguistic) form. The TD and DL cells are concerned with both visual and verbal information.

The differences between the three groups does not begin to become apparent until one looks at **what prompted** the experts to notice problems in the text/illustration combinations. To identify that which prompted experts to notice problems in the combinations, or the problem *source*, I reviewed the transcripts in terms of what experts were attending to as they articulated their perception of the problem. I coded three different kinds of problem sources: text as source (T source), illustration as source (D [for design] source), and prior knowledge as source (M [for memory] source). For example, a problem coded with a text source for a particular expert would be a problem articulated by that expert as she was reading (attending to) the text itself. (In the following examples, boldface mark text being read, underline notes text being reread, italics marks text being written, and plain typeface indicates spoken comments.) For example

> **"If a spore lands on a suitable surface such as another piece of bread it germinates and starts the cycle over again.** How long was that cycle? Is this happening at lunch or over a week? They're stressing how, how, how....the cycle and how many, but you're not telling me how long!"

Here, the recognition of problems in the text which were prompted by the text itself. Experts found the text problematic either through ambiguity or missing information in the text, or through confusing syntax.

On the other hand, a text language (TL) problem coded with its source in the illustration/design (D source) was a problem articulated by an expert as she was attending to the illustration. For example

> **"Notice on the map that the direction of ice movement is not everywhere the same.** There's no information on the map that says that. So I don't know how you can be expected to notice on the map, get that information from the map. It isn't on the map. So, I'm just going to encircle that sentence and question that. "

In the next example, an expert articulated a problem he recognized in the use of typographic cues (TD) after reading the text (T source).

> "Now why, why is some of this italicized? Why is rhizopus italicized here when it isn't italicized at the beginning of the paragraph?"

Other problems were coded as TD problems with their sources in the illustration (D).

> "Its not very easy to find the boldface words (those in the text) in the illustration."

Experts noticed labeling problems in the illustration (DL) both as they were attending to the text (T source),

> **"Its hyphae form a white cottony mycelium**...."What's a hyphae...this hypha is not labelled anywhere."

and as they were attending to the illustration (D source).

> "I'm going back to the diagram to see if it gives me any clues...There's, there's no title on it, which is really bad. "

Finally, experts mentioned problems they found in the overall design of the illustration (DD) both after reading the text (T source) and after evaluating the illustration (D source).

In addition to the features of the text or the illustration prompting the recognition of problems, experts also recognized problems simply based on their prior knowledge of the topics being discussed (M [for memory] source).

> "Each unit of protoplasm contains a nucleus...That doesn't mean anything... Um, there, I mean that's an artificial invention. There is no such thing. "

Problems coded with a prior knowledge source were ones experts immediately recognized without questioning or being confused by either the text or the illustration.

When the problem data is analyzed in terms of source, distinct differences between the expert groups begin to emerge (see Figure 8).

Designers

	Text	Illustration	Memory
Total #	152	83	1
% source	64.4	35.1	0.5

Editors

	Text	Illustration	Memory
Total #	157	52	3
% source	74.1	24.5	1.4

SMEs

	Text	Illustration	Memory
Total #	84	49	84
% source	38.7	22.6	38.7

Fig. 8: Number and percent of problems recognized by each group via text, illustration, and memory sources.

The first and most prominent difference is that SMEs relied on their prior knowledge (memory) to detect and diagnose problems in the text/illustration combinations substantially more frequently than either designers or editors. Across all three text/illustration combinations, SMEs used prior knowledge to detect and diagnose almost 40% of the problems they noted, compared to 1.4 % for designers and .5% for editors. Even in the Ice text/illustration combination, whose content was farthest from the core expertise of most of the SMEs, these experts recognized problems based on their prior knowledge substantially more frequently (15%) than either designers or editors who, basically, did not use prior knowledge at all. Interestingly, in interviews after the revision sessions were complete, many of the experts (those in all three groups) said they felt they had some knowledge of the topics of the text/illustration combinations.

Another feature of the differences among the experts is that both designers and editors were routed to problems in the text/illustration combinations much more often via the text than by the illustration. In other words, designers were prompted to notice problems more by the text (64.4%) than by the illustration (35.1%); editors were prompted to notice problems more by the text (74.1%) than by the illustration (24.5%), but SMEs were prompted to notice problems comparatively less by the text (38.7%) and more by their prior knowledge (38.7%).

Student responses

As mentioned earlier, additional analyses of the data have looked at how the students' perceptions of problems in the text/ illustration combinations compare to those of experts. In short, the experts and students perceptions of problems in the text/illustration combinations differ dramatically. Although students did notice some of the features of the text/illustration combinations that the experts noticed as problematic, they also misinterpreted the texts and illustrations in ways completely unpredicted by experts. For example, in the Ice text/illustration combination (see Figure 1), one student incorrectly interpreted the text/ illustration as showing the glacial ice eroding land from the Cape Cod area, rather than depositing the material to form the peninsula. Another student interpreted the combination as showing the glacial flow creating the coastal outline of New England, which also is not correct. Other features of the text/illustrations predicted by the experts to be problematic for the students, such as an abundance of latinate words or lack of definitions, seemed not to bother most of the students at all.

LOOKING FORWARD

The analyses discussed in this article show that, despite some similarities, experts from different disciplines have different motivations and use different strategies to guide their revisions of text/illustration combinations. Among the most noticeable of these differences is that editors are acutely aware of the other collaborators working with text, while SME's are primarily concerned with student's as audience. These differences in rhetorical constraints seem to have affected the revisions that experts chose to make. Another difference between the three groups was that SMEs relied on their prior knowledge of the topical content of the text/illustration combinations to help them detect and diagnose problems; this strategy, however, did not lead the SMEs to detect any more or any different problems from either designers or editors.

To date, this study has yielded two preliminary conclusions. The first conclusion is that more detailed studies of individuals rather than groups may be the most productive route to follow in building comprehensive models of visual/verbal problem-solving behavior of both experts and novices. Closely linked however, is the second conclusion: prior knowledge and rhetorical constraints, such as the role of audience, play an important role in visual/verbal problem solving strategies, and thus are critical features to include in future studies.

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Researching Instructional Materials Evaluation: Adding Socio-Cultural Dimensions

by

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Research Project-Overview

Critical evaluation of instructional materials is an important but often neglected aspect of instructional preparation. Teachers do not usually select their instructional materials (in whatever the format) according to formal, generalized, research-based prescriptions for doing so. And only rarely do teachers consider criteria beyond those which are achievement and technically oriented (Rothe, 1991). Instead, we are likely to develop and use our personal, situated routines to select and evaluate materials. This study suggests evaluation that is more theoretically grounded in socio-cultural and local, context-sensitive bases than are many current selection/evaluation guides. It reviews the development of evaluation tools, provides new measures, and applies new measures to current visual materials. Using historical, formalist, and aesthetic methods, a new evaluation instrument was developed and applied to materials for teacher education. From preliminary research in this area, we expect the interpretation to reveal a number of explicit and implicit ideological stereotypes and assumptions about our beliefs about teachers, teaching, classrooms, and mediated education. We believe as our project continues that examining this visual material will provide new understanding of our field and our educational beliefs.

Background and Rationale

Evaluation of materials has traditionally been derived from the behavioral theory and the systematic design of instruction so basic to our field. However, the limitations of these theories as a basis for evaluation or selection of materials have been repeatedly pointed out by current critics of educational technology. Bowers (1988) discusses the "current blindness" of the "conduit" view of software evaluation, for example (p. 47). Bowers goes on to critique the instructional procedures of an evaluation model based upon Gagne's events of instruction. He points put that such a model ignores the subjectivity of language and the awareness of the influence of language on thought. This is just one example of criticism which points out the severe limitations of our current evaluation models.

The field of educational communications needs to revisit our theoretical basis for the simple models of evaluation or selection which we have been teaching for so long. Kerr (1985) has suggested that methods drawn from sociology, policy sciences, and anthropology could "shed new light on problems that have traditionally been approached using psychological research methods" (p. 4) Kerr felt that asking new questions in less traditional ways was critical to the future of education. With more multi-cultural and critical dimensions of education becoming a reality, the area of materials evaluation and selection and the messages being given to teachers need to be re-examined.

Eisner (Eisner and Peshkin, 1990) suggests new methods and comments on the limitations of old models. "The methods into which we have been socialized provide powerful filters through which we view the world. If we are predisposed to focus upon the unique features of a person or situation and skilled in their literary description, we are likely to attend to classrooms in ways that emphasize or make salient the idiosyncratic. If we are inclined toward the description of measured relationships or the incidence of events, if what we are inclined to think about is how things co-vary, we see the "same" classroom from a very different angle and with a very different intent. In short, our methodological concepts influence our perception. Thereafter, cognitive maps help us find our way in the territories we wish to explore. Those with different maps tend to take different roads." (p. 9)

Yeaman (1991) discusses the importance of the socio-cultural aspects of our field, which he calls neglected. "Educational communications and technology research concentrates on the efficiency of learning stimuli, instructional techniques and matching these with student characteristics." (p. 990)

And Ellsworth (Ellsworth and Whatley, 1989) has commented that: "Such research privileges questions of how individuals process information from educational media over and above questions about the ideological work of meaning construction, content selection, setting of objectives, and media use. The concept of information processing as developed within cognitive psychology and applied in educational technology cannot explain meaning, intent and significance." (p. 49)

An examination of evaluation from a socio-cultural viewpoint begins to provide more powerful and meaningful dimensions in the evaluation of media materials, historical or cutting edge. This project integrates media criticism and post-structuralism as a basis for improved evaluation, and provides a sample application. The application involves teacher education visual materials: film, video and multi-media.

Teachers have conceptual and attitudinal knowledge of technology based on the media used to teach them about the technology. These media remain largely unexplored from both an aesthetic and a critical or formal perspective. Likewise, only recently have a few scholars turned their attention to the older educational films and videos in order to explain their messages, overt and otherwise. The visual representations and the actual construction of knowledge in these materials are now beginning to be investigated. Ellsworth's (Ellsworth and Whatley, 1990) research is an example of such work and is used to guide the work presented here.

In their text, *The Ideology of Images in Educational Media*, (1990), Ellsworth and Whatley discuss this recent move to examine the ideology of images. They point out that until very recently, educational communications research was still focused on effectiveness and on how learners gain from mediated messages. Recently, educational media researchers have turned their attention to educational films and other materials, and are investigating the visual representations and the actual construction of knowledge. Ellsworth cites examples of studies using science and health films and print materials.

Using Ellsworth's text as a model, this project involves materials used to teach teachers about communications media and "technology." Many such materials have been produced and used in college classrooms to introduce the use of "amazing" new media to future teachers. Most university film or media libraries have many such materials in their collections, some dating as early as the 1940s and some as recent as 1990. These films, with titles such as *Teaching with Sound Film* (1940, Encyclopedia Britannica Education Corp.) and *Audio Visual Materials in Teaching* (1956, Coronet Instructional Films) were designed and produced to encourage future and current teachers to properly and effectively use 16mm films in their classrooms.

Anticipated Outcomes

The aim of this work is to begin an historical record of our field in terms of film and video; to bring a more grounded and broadly literate understanding of instructional materials to both theorists and practitioners; and to suggest substantial changes in the ways teachers evaluate curricular materials for teaching.

The results will be summarized and examined for the messages we can discover involving materials, teachers, pedagogy, and technology. In addition, this work will focus on the hidden curriculum of such messages, describe what was considered valid knowledge, and determine who possessed it. Our educational culture will be described, and new ways of looking at educational media will be explored. In completing this project we will produce a brief history of the teaching of media utilization and evaluation, a new evaluation tool, and analysis of several mediated materials. These outcomes should be useful to those working on visual literacy enhancement in pre-service teachers.

Research-in-Progress Workshop Conduct

The workshop in Pittsburgh had three sections, and was part of the research process. Part one reviewed the development of evaluation measures from an historical perspective. Several older evaluation instruments were shared to present an overview of the elements common and unique over time. Evaluation instruments representing five decades revealed common concerns for educational film content, technical quality, and audience appropriateness. The earliest form (Devereux, 1935) was rigorous and detailed reflecting concerns related to the instructional vs. entertainment issues of the era. Current forms were streamlined to brief "reviews" incorporating likert scale ratings with opportunities for comments.

The second section used a popular appraisal instrument (Heinich, et. al., 1989, p. 238) to allow participants to evaluate an older educational film entitled "How to Use Classroom Films" (Crm/McGraw-Hill Films, 1963). With categories including Relevance, Effectiveness, and Pacing to guide the evaluation process, this instrument lead participants to comment upon the film's likely success in teaching teachers about the use of film. Since the material was dated, the participants could concentrate upon the production's style and the evaluation instrument. The appraisal checklist as presented was found to be missing important aspects. Participants in discussions observed that teachers in the film were considered consumers of materials and were encouraged to examine materials for their objectives and effectiveness alone. Criteria involving bias were limited to one line, and were unexplained. Teachers, it was noted, were also given little input as to the possible uses or value of the material.

Section three introduced postmodernism and its emergence as an important viewpoint for educators (see Suggested Reading List). Questions raised by a postmodern perspective include issues of emancipation, ethical behaviors, and empowerment. In media postmodernism leads us to question who is delegitimized and "othered" by mass media such as television. These same questions were then raised while reviewing a newer educational videotape from a series. A new evaluation form based upon work by Rothe, (1991) was shared. This form was prepared using socio-cultural analysis aspects to provide several meaningful new dimensions to the evaluation process (see Instructional Materials Evaluation). Participants were invited to use and critique this new instrument, and comment upon its perspective and its usability. Discussion followed about the process and the viability of socio-cultural evaluation in schools and by teachers. The new form encourages viewers to "see" in a new way; to not ignore important if subliminal visual aspects.

Copies of handouts are included after the references so that readers may participate further in the ideas suggested by this research. People wishing to field test the new instrument should contact us for further information; we are interested in its use and dissemination. Any suggestions or additions readers wish to recommend should be sent to the authors.

This research project, as it continues, hopes to establish new criteria for the examination and use of visual materials. Teacher educators and teachers will promote a more visually literate audience with these materials.

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Instructional Materials Evaluation

Title: ______________________________

Source, Date, Length, Cost: ______________________________

Subject Area/Audience: ______________________________

Brief Description/Subject Matter: ______________________________

____

Language Usage	Does Not Apply	Not at All Poor	Some-What	Completely Well
1. Is the language used context specific?				
2. Will students understand the concepts presented, especially those presented within metaphors using familiar words in new ways?				
3. Is one point of view presented without the acknowledgement of other possibilities?				
4. Is the language used appropriate to the content but broad enough to allow other points of view?				
Comments:				
Perspectives				
5. Is the framework for content selection explained?				
6. Is the design of the information obvious? Are designers' choices explained?				
7. Does the knowledge presented allow flexibility for student and teacher involvement?				
8. Is this material marketed in an easily usable and available format?				
9. Is material designed to reflect mainstream society's assumptions concerning relevant cultural features such as responsibility, education, career, family, religion, etc.?				

Perspectives Cont.	Does Not Apply	Not at All Poor	Some-What	Completely Well
10. Does the material promote and reflect the distinctive character and values of all cultures?				
11. Is this material directed to the largest number of users to the exclusion of minority or smaller groups within the educational population?				
12. Is the value framework for this material evident?				
13. Are the students or teachers given the opportunity to question or explore the values framework used?				
14. Do the values presented interface with the values held by users?				
Comments:				
Curricular/Strategy Issues				
15. Is this material promoting effective and efficient learning to the exclusion of more broadly-based learning outcomes?				
16. Is the underlying message of this material that technologically driven learning is preferred over other types of learning?				
17. Is the material appropriate educationally rather than selected as a result of some commercial effort?				
18. Is using this material the soundest solution to the educational problem involved?				
Comments:				

Derived from Rothe, J. P. (1991). Critical evaluation of educational software from a social perspective: Uncovering some hidden assumptions. In Hlynka, D. and Belland, J. (eds). Paradigms Regained, New Jersey: Educational Technology Press, pp. 367-384.

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Using Drawings to Teach and Videotapes to Evaluate Beginners When They Learn to Ride

by

Karen K. Block

Introduction

Within physical education, the use of diagrams, and more recently, videotapes has been encouraged as a way to help students learn position and movement. In fact, one commercially published magazine (*Practical Horseman*) that is fairly technical and the outlet for much expert opinion has published a recent article on how to incorporate videotapes into riding and learning to ride. Nearly every horse show and riding clinic has in attendance numerous video cameras, some of which are operated by professionals who then sell these tapes for profit. Friends and family members are often steadily engaged in videotaping, for the later consumption by riders. The use of videotapes and other visual aids is popular and widespread, finding much use often by amateurs and outside of the formal instructional setting.

Do these popular visual adjuncts work to assist learning? Many riders will testify that video information is helpful, yet it has not been demonstrated empirically that riding is better following exposure to such aids and information, compared to the effects of just riding more. This study is a small exploratory study designed to test the effects of drawings used to help beginners learn to ride, and to explicate the issues involved in seeking answers to such questions.

In this study, several beginning students, in their seventh hour of learning to ride, rode at the walk and the trot, and some of them were given feedback on body position in the form of drawings made by their peers. They then rode again. It was assumed that drawings would function in learning riding as they have in other learning research. (see Kozma, 1991). According to social/cognitive theory, it could be expected that as learners attend to the drawings, they extract information from them and form a cognitive representation. This information then serves as a guide for action when they ride again, after viewing the drawings. This generally stated theory supported by previous research using drawings during performance suggests that other things being equal, drawings ought to be helpful to students, although we cannot say that they are the MOST helpful form of feedback and intervention.

Subjects

Undergraduate students in a beginning horseback riding class were the subjects for the study. These were students who had minimal riding experience before they came to this class and they were in their seventh hour of instruction. There were 10 students enrolled in the class; on the day of the study, nine were in attendance. Four students were randomly selected to ride and out of the four, two were randomly selected to be drawn and two were not drawn. The other six students did the drawings while observing the riders ride at the walk and the trot. Which student drew which rider was also randomly determined.

Instruction and Procedure

The student drawers were seated at a desk behind the observation wall in an indoor riding ring. From the desk, they could observe all students riding in a line wherever they would ride in the arena. Drawers' eyes were about at the level of the riders seat. The drawers were told to draw their designated person while that person rode, and to pay attention to the instructions on their sheet. (Study your rider, draw an accurate view including flaws, use your yellow highlighter to help the riders notice flaws they should correct). They were also asked not to talk to each other until the drawings were finished. The drawers had a period of 15 minutes in which to complete their drawings.

The student riders were assisted with tack and mounted as usual. They began riding in a line on the wall as usual. During the period of drawing, the first fifteen minutes, they rode first at the walk, then at the trot, and the video was taken by the instructor and her assistant standing in the center of the ring. An attempt was made as much as possible to get each rider for a period of time going to the left and to the right at each gait. Approximately eight minutes were spent going in one direction, then the direction was changed by a figure eight in the arena, and the other direction was taken. There were no position design clues given by the instructor during this time; riders were only told to shorten their reins, or to keep their horse on the wall. This instruction was necessary for a safe and organized class at this level.

After the drawing period was completed, student riders were handed drawings of themselves and gathered in the middle of the ring. The two riders drawn were told to look at how they had been depicted in the drawings. They were then told to "use what they saw to help them ride better". They were given approximately two minutes to look at the drawings.

The control students were told to think about how they just rode. They were asked to imagine what could be better, and to pick two or three things to rehearse mentally, and then to practice when they were out (on the arena wall).

The riders rode again, being told they would probably be helped by their warmup (control) or their drawings. Riders rode the same pattern as before in the same order. In both phases, pre and post, a rail had been placed in the center of the ring so the riders would cross it when changing direction. It was felt this action would provide a bit more information about the effectiveness of the riders position to the drawers and later to the observers.

Observers

Five experienced hunt seat riders observed the video tapes. Each observer presently owns or has owned a hunt seat horse and all riders have competed in hunter shows. All riders have spent at least one full year, and up to 10 years enrolled in formal hunt seat riding instruction given by legitimate professionals who show and teach. Three observers have had very extensive experience teaching hunt seat to beginners, one observer is becoming involved in teaching. All observers are college graduates and one observer graduated from a school emphasizing equestrian studies.

The observers completed rating sheets describing position and movement characteristics for each rider observed. They evaluated the riders blind. They were asked to also comment on the aspects of design rated. The aspects of position rated were body position and parts alignment, and adequacy of base of support. The aspects of movement rated were motion in concert with the horse (or not) and whether there were errors in motion (or not). The ratings ranged from strongly disagree through no opinion to strongly agree. Spaces below the rating continuums were provided for comments.

The researcher cycled back and forth through the video tape to assist the observers while they did their ratings. Many looks were taken of all students during walk and trot, pre and post. Observers also studied riders in slow motion. The entire rating task lasted about 45 minutes indicating by the time taken and comments made ('This is hard', 'Let's see that again'.) they took their job quite seriously. Observers saw tapes singly and in pairs; no conversation about riders was allowed.

After rating each rider, observers were asked to match the student generated drawings to the riders they had viewed. There were three drawings of one rider and two of the other, with one "distractor" drawing of another student. These six drawings were matched to all four riders, even though, two of the riders had not been drawn by the student drawers.

Equipment. The video camera was a Zenith 360. The receiving was transferred onto a regular VHS tape and played on a four head Panasonic VHS playback.

Results

The results of this study can be described in terms of a simple model for how drawings might be expected to influence learning to ride. In a simple world, the drawers would draw the riders highlighting their most obvious position flaws, and it should be possible to clearly see such flaws in the pictures generated. When given the pictures, the riders should notice such clearly illustrated flaws and aim to correct them. They should encode and rehearse perhaps enactively how they will change their positions when they ride again. Such position changes, if they are in fact major ones, ought to be noticeable by the observers when they study the videos in the post phase of this riding study. Such changes ought to affect their rating behavior and their comments about the riders.

The five drawings of the observed riders were line drawings of side views of position design. The yellow highlighter was used on every drawing to highlight flaws, which varied in number from one to three. Often, text was also used to explain the flaw (for example, "looks down"). The drawings were basically easy to see and interpret.

1) Were the drawings accurate?

To answer this, the flaws noted for each rider were compared. In the two drawings of one rider, drawers agreed in noting a round back, but one drawer also noted "hands up", while the second one did not, either in highlighting or in the figure drawn itself. In three drawings of the second experimental student, two noted a round back, lack of heels down and eyes down--three classical flaws--while the third drawer noted a round back (a flaw shared with the other two), "good hands" (a plus not noted by either of the other two), and a "good heel" which is in conflict with the drawings of the other two student observers. Therefore, what students observe and choose to highlight can vary among them both in number, in kind, and in accuracy. Perhaps rather than relying on students' memory of what is proper position alignment, this task would be better served by having a standard present to remind students of what to look for.

A second analysis of the drawings was done by determining whether the observers could identify the student riders from the drawings alone. Three things were clear from this analysis. First, drawings by two student drawers of the same rider and horse can be perceived very differently. One example drawing of the rider on Strawberry (the horse) was identified correctly by four of the observers. The second example drawing of Strawberry and her rider was not correctly identified as such by anyone--they all thought it was another rider and horse, and who they thought it was varied. This inconsistency of identification is probably due to the information contained in the drawings--the correctly identified one had two flaws present in the drawing, and the drawing not correctly identified had one flaw noted, a flaw which was shared by all of the student riders and thus not distinctive to Strawberry's rider (this flaw was a roundback).

A second analysis considered confusions and what rider was thought to be what other rider. This analysis showed riders having common positions and position flaws were most often confused. Also, observers when they identified riders in drawings paid attend to nonhighlighted cues too. One drawing showed a rider leaning forward, quite forward yet their back was not highlighted as a flaw. Yet the drawing was still identified as that rider who "leaned forward a great deal". From these data on drawings it can be said that the drawings students generate as diagnostic aids did not function as stand alone pictures.

2) What effect did drawings have?

It was expected that drawings would help students correct their position design flaws in that attention to such flaws was called for in the drawings. Of the observers whose post ratings were higher than their pre ratings for these students, their comments were studied for the presence of words and phrases noting improvement in the drawn body parts. For the experimental rider on Strawberry, three of the five observers noted post phase improvement. Two observers of the three observers mentioned hands as improved, the third did not specifically mention any of the drawn flawed body parts. Thus where judged improvement existed, and could have been described as being located in hands, shoulders, back, upper body (the highlighted flaws), only one body part was mentioned and only by two of the three observers. In the second experimental subject, the rider on Mariah, the drawings highlighted eyes, back, shoulders, heels and hands. Three observers judged this rider as improved. Of these, one mentioned two parts--back and heels. One mentioned legs, which is not as specific as the flaws represented in the drawings. The third observer mentioned head, which also is not as specific as in the drawings. The data is not overwhelmingly in favor of any direct corrective effects of drawings. That is, according to three target observers' opinions, student riders do get better, but this is not, in their observations, necessarily due to a strategy of correcting flawed parts.

3) Nature of improvements.

So then what did improve, according to the comments made by the observers? These comments, made by observers who scored these students better in the post phase than in the pre, focussed interestingly enough, on rider. movement and balance, dynamic aspects of riding. It was stated by these three observers, that the riders had... "better motion with the horse, follows well, has improved balance and rhythm, and there is no jabbing (of the horse in the mouth)." Mentioned also was the position concept of "alignment" ....improved alignment....but one observer also made the telling and important point that...."alignment does not tell the whole story; movement over the cavaletti (rail on the ground negotiated at a trot) is very important." It seems therefore that one reason a direct connection did not seem to exist between drawn flaws and rider performance improvement is that when observers evaluate riders and their skill, they are looking beyond form into function, that is, into rider effectiveness and security and non abuse of the horse. These qualities are described by such movement concepts as balance, rhythm, base of support, steadiness, and so forth. It would certainly seem that if these are the focal and valued ideas that came into play when evaluating riders, then what the observers have had to do in this instance, where the video showed mostly work on the flat, is to some extent infer from adequacy of position design just how good balance and rhythm and security actually are. In fact one observer explicitly stated..."I know this rider looks good but I keep waiting for her to fall on her face."

It would seem that rather than having to infer how secure a rider probably is from looking at and then beyond his or her position design (and this is emphasized in instructional texts and videos too) while working on the flat, it makes more sense to allow direct observation of riders negotiating simple obstacles and to make this a central part of rider evaluation. To date, of course, the classical texts in rider education emphasize static position design objectives. Attention is also given motion concepts but these are very difficult to portray well in a static medium. There is an increasing need to design and produce video materials that can be incorporated into rider education which address these important dynamic aspects of skill quite directly.

Systematic treatment of motion concepts could help in both learning to ride and in enhancing the evaluation of riders. It was found in this study that riders who are evaluated as the "better" riders (ranks 1 and 2 in overall scale points) were ranked fairly consistently across all scale dimensions by the observers. In contrast, riders evaluated as "poorer" riders are not ranked consistently across the four dimensions by the observers. There is great inconsistency and wide variability in the distribution of scale responses. Perhaps this is due to an attempt by observers to assess the likely effects of serious disturbances in position on the dynamic aspects of skill. Such assessment comes out good (in the ratings of some) and bad (in the ratings of others). Very possibly, if rider motion is a specific object of study, such assessments would not be so varied.

Thus far we have seen that observers appeared not to look directly for the numerous position flaws portrayed in students' positions and portraying in the drawings. Another way to examine this question of the effects of the drawings is to look only at the scale question on "rider position" to see if any increase in rating was obtained from pre to post, for the experimental riders and for the control too, by comparison. For the position question, the rider on Strawberry was judged worse (-2 points) by one observer, no change by two, and improved by two (+1 and +2 points). The rider on Mariah was judged worse by two observers (-2 each) and no change by three. For these experimental subjects, the drawings did not have a consistent effect of improving position.

For the control subjects, the rider on Magic was judged worse by one observer (-2), no change by three observers, and better by one (+1). The rider on Tory was judged improved by two observers (+1 and +2 points), no change by three, and improved by one (+2). It cannot be said that drawings had a helpful effect, relative to just riding more, on this position dimension, which is the one dimension drawings were thought to influence.

The other three dimensions of the rating scale were subjected to the same kind of analysis. These were "base of support", "in concert with the horse", and "errors while riding." These dimensions showed a quite different pattern. There was very little change noted for the control riders and horses on these dimensions; in fact mostly no change was recorded. In contrast the experimental riders and horses showed the most change with the net result a positive one. Out of the total of four dimensions, with five observers and four riders on horses (total of 80 observations), it was found that of the forty observations associated with the experimental group, there were 19 no changes and a total change score of a net of +20. Out of the forty for the control group there was a total of 32 no changes, with a net of +9. These data do suggest that drawings had an effect, but not the simple one we expected. The other dimensions of performance were mostly affected.

It is not possible within the confines of this study to say uniquely why drawings seemed to affect dimensions of riding skill other than those directly drawn (the position design dimension). Perhaps position adjustments in riders are not really salient in a video, or perhaps position features were not systematically looked for or the focus of attention, or perhaps position features were devalued in the eyes of the observers who preferred instead to emphasize the functions that the form is supposed to support. Or, perhaps basic drawings have effects on dynamic aspects of skill.

In summary, the results of this study show a simple direct correction model does not account for what dimension of riding performance drawings seem to affect. Rather, drawings seem to assist change in other, related dimensions of performance which in turn observers focus upon. This suggests that video aids to riding instruction ought to involve methods for making dimensions of skill such as balance, rhythm, and base of support and variations in those dimensions more readily apparent.

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International Icon Symbols: How Well Are These Symbols Understood?

by

Robert E. Griffin and William J. Gibbs

Background

There has been a growing tendency in our society to replace printed textual messages with symbols. The argument for replacing words with symbols centers around the hypothesis that symbols convey meaning more efficiently than printed messages. Many believe that symbol use is supported because symbols can be perceived more readily than text[1]. Tierney and King found that symbol perception[2] was quicker than textual perception. Pettersson acknowledges that it is a widely held belief that symbols have become a language of their own[3]. A further belief is that symbols impart meaning despite cultural barriers. Two researchers, Mackett-Stout and Dewar, state "Because many symbols have the potential to be universally understood, language barriers are circumvented"[4].

While some research has purported the utility of symbolic visual communication, controversy still exists over the comprehensibility of many symbols. Gustafson and Roettger reported significant differences in pictorial recognition resulting from picture content and complexity[5]. A symbol may be identifiable but a measure of its usefulness is how well it is understood by the viewer. Symbol comprehension thus is one of the most critical ingredients in measuring the value of any symbol[6]. As the variety of symbols used for visual communication increases the likelihood of them being misinterpreted is great. The implications of misinterpretation are significant in hazardous situations, for example, traffic control situations and toxic environments. As Mackett-Stout and Dewar point out, the rapid development of symbols has brought about a diversity of symbolic versions of identical messages[7]. The need, therefore, to develop methods to evaluate the comprehensibility of symbolic messages is paramount[8].

Purpose of the Study

There is great reliance on symbolic messages in our society. This proliferation of symbols appears to suggest the evolution of a visual language. Communication through symbols, however, necessitates that they be interpreted correctly. Given this assumption, this study set out to test the hypothesis that the symbols used on overhead transparencies, slides and electronic visuals enhance the message for audiences that are not fluent in the language of the presenter. Specifically, the study investigates the variability of subjects' interpretations of commonly used visual symbols. It examines whether the interpretations made by a U.S. audience differ from the those of a Jamaican audience.

Subject Population

Two groups of students were surveyed for the study. The first consisted of 27 Executive MBA students enrolled at the University of the West Indies located in Kingston, Jamaica. The second group consisted of 160 first year MBA students at Penn State University enrolled in a Business Communications course. Of these 160 students, 61 had citizenship other than the United States. Because an aim of the study was to observe cultural differences in symbol perception between Jamaican and U.S. audiences, it was necessary to control cultural diversity with the U.S. group. The responses of the 61 international students were eliminated for the analysis and only U.S. citizen data analyzed. Thus, the total number of subjects in the second group was 99.

Procedures

Subjects received a questionnaire on which they had to identify 48 black and white symbols. The analysis examines a subset of 12 of the 48 symbols used. A listing of symbols, their designated titles and difficulty indexes are shown in Appendix A.

Subjects were asked to construct an open-ended response to identify each symbol. This response mode was chosen rather than multiple choice to prevent cuing subjects to the symbol's meaning.

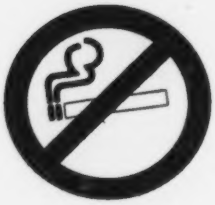
After collecting the data, all subject responses were reviewed and categorized. Each symbol had a fixed set (no more than 6) possible response categories which were established by the researchers. Categories for each symbol were derived from the subjects' responses to that item. Responses were classified into categories by the researchers. Each category had a Correct Response category and an Other category along with various other responses.

Analysis and Discussion Of The U.S. Data

Efficient symbol identification is based on symbol familiarity[9]. The more familiar an individual is with a symbol the more readily he/she will identify it. It was expected that the U.S. audience would easily recognize and identify the symbols used in this study; however, this was not the case. The average difficulty index for the 12 symbols in the study was .452 when measured on a scale where .0 is unrecognized and 1.0 is completely recognized. A difficulty index is calculated by dividing the number of correct responses for an item by the total number of responses for that item. The difficulty index of .452 indicates the audience recognized less than half of the items correctly. This is hardly evidence that a language of symbols exists. Further, it indicates that various interpretations are common for even frequently used symbols.

The best recognized symbol of those presented to the U.S. subjects is shown in Figure 1.

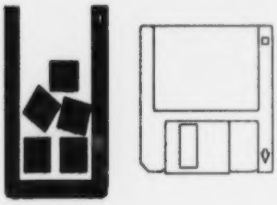
Figure 1
Best Recognized
Symbol - U.S.



This symbol is widely seen in many public places within the U.S. It is commonly referred to as the No Smoking symbol and cautions the audience that smoking cigarettes, cigars and pipes is not permitted in the area where the symbol is displayed. All 99 U.S. subjects in the study correctly identified this symbol. Its difficulty index was 1.0.

The two least recognized symbols in the study are shown in Figure 2.

Figure 2
Least Recognized
Symbols - U.S.



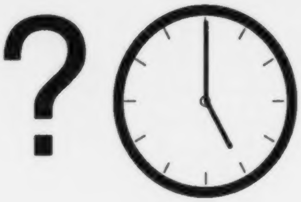
The symbol on the left in Figure 2 is identified by the artist that created it as A Glass Of Ice Cubes. None of the subjects identified the symbol by this description. The responses that were given for the symbol were: Trash Can (28%), Ice Machine (26%), Unknown (25%), Drink (8%), and Other (12%). Note that percentages which do not add to 100% are due to rounding. In the researchers' judgement the second most desirable response could have been Drink, however, only 8% of the subjects selected this response. From this data it appears that this symbol fails to communicate the concept of a glass of ice or an iced drink. Possibly the level of abstraction deterred the audience from correctly identifying it. Abstract symbols are more difficult to interpret than those which are more concrete[10].

The other poorly recognized symbol is the one on the right side of Figure 2, a 3.5 Inch, Low Density Floppy Diskette. No one correctly identified this item. Many readers may consider this response a trick question because the responses given for the question were: Computer Disk (54%), 3.5 Floppy Diskette

(27%), Unknown (10%) and Other (9%). The trick to the question was the alignment hole on the right top of the computer disk. The hole is an alignment hole that tells the computer the diskette is a low density diskette. Most may judge this as a minor point, however, the researchers believe the fact that many people did not properly recognize this symbol is significant. It demonstrates that people did not read this visual for detail. The current audience appeared to view it in a superficial manner. Pettersson refers to two levels of image perception. In the first, the low cognitive level, the viewer takes a holistic view of the image and processes it quickly. Pettersson cites, "The information is handled as a whole in parallel, simultaneous, tentative, rough, holistic and fast processing"[11]. In the second level, the high cognitive level, he says additional processing occurs. "Certain details in the image attract more eye fixations. The information is processed again, several times, detail by detail"[12]. It is possible that the symbol of the computer disk was perceived at a lower cognitive level. The detailed processing associated with a high cognitive level of image perception appeared to be non-existent. For the U.S. audience this lack of processing may be due to their familiarity with a computer disk. Their immediate recognition of this symbol may have prevented further detailed processing.

Three additional observations should be made from the U.S. data. First, subjects showed an ability to read compound visuals as visual sentences. The symbols shown in Figure 3 are a grouping of a question mark and a clock.

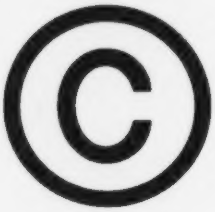
Figure 3
Compound Symbols



The artist who created the symbol asserted that this grouping meant "What time is it". Most subjects (70%) correctly identified this grouping of symbols. It appears that multiple symbols can be grouped to form sentences.

The second interesting observation was the inability of the subjects to recognize Figure 4 as the copyright symbol.

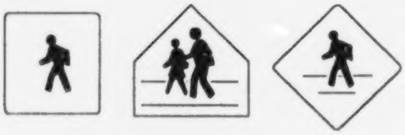
Figure 4
Out of Context
Symbol



Only 26% of the subjects correctly identified the symbol. The remaining responses were: Unknown (43%), Other (26%) and Letter C (4%). Surely the copyright symbol is one of the most widely used symbols, but it does not appear to be readily recognized. The researchers assume that the difficulty in recognizing it had to do with the symbol being presented out of context. "A context within which a symbol is presented has a significant effect on how it is perceived"[13]. "It is quite conceivable that people who understand the generic concept conveyed by a given symbol may fail to correctly infer its meaning in a particular context because they fail to correctly perceive its referent"[14]. Normally the copyright symbol is presented in a very small typeface with descriptive information following the symbol. In the current study, however, it was presented without description.

The third interesting finding in the study was the confusion of three traffic symbols. These symbols are shown in Figure 5.

Figure 5
Traffic Symbols



The symbol on the left of Figure 5 is a Walk symbol. It is used on traffic signals in towns where pedestrian traffic is controlled. When pedestrians are permitted to cross the street the walk signal is illuminated. This symbol was only identified by 16% of the subjects. It was most often identified as a Pedestrian Crossing (63%).

The symbol shown in the center of Figure 5 is School Crossing. It is used as a traffic sign, black characters on a yellow field, to designate school children crossing the street A large percentage (63%) of subjects identified it correctly although a number of subjects (29%) identified the symbol as a Pedestrian Crossing. There was obvious confusion between pedestrians and children.

The symbol on the right of Figure 5 is Pedestrian Crossing. This symbol is also used as a traffic sign and is located at areas where pedestrians are likely to be crossing from one side of the street to the other. The sign again has black characters on a yellow field. This symbol was one of the better recognized symbols with 88% of the subjects recognizing it. Only 1% of the subjects confused this symbol with the school crossing symbol.

Fisher notes the adequacy of traffic symbols has been the focus of much empirical inquiry[15]. Some methods for presenting traffic information have been shown to be more effective than others, however, much controversy exists pertaining to engineering traffic control messages[16]. The three traffic symbols presented in the current study appear to lend support to the lack of reliability of traffic control messages. While confusion over these signs will probably not result in safety problems, it should be remembered that they are presented in every driver safety education manual and should be well known. Even the meaning of frequently used traffic symbols can be misinterpreted.

Comparison Of U.S. and Jamaican Data

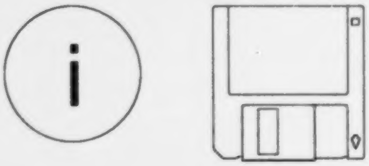
This study was originally developed to test the hypothesis that symbols were good to use on overhead transparencies, slides and electronic visuals when audiences were not fluent in the language of the presenter. The assumption was that symbols helped the audience understand the written words on the visuals. This situation is common in today's world of international business. For example, it is common for English speaking business people to be doing business with the Japanese and any means of maximizing communication is beneficial. Conventional wisdom has always suggested that if a visual designer used commonly identified symbols on the visuals the audience would better understand their purpose.

The Jamaicans were less able to identify the symbols than the U.S. subjects. While the U.S. subjects had an average difficulty index of .452, the Jamaican subjects had an average difficulty index of.253 for the 12 symbols. This suggest that Jamaicans had more difficulty interpreting symbols than U.S. subjects.

The No Smoking symbol was recognized by 96% of the subjects. It was the most recognized of all the symbols used. This result is consistent with data obtained from U.S. subjects.

The least recognized symbols for the Jamaicans are shown in Figure 6.

Figure 6
Least Recognized
Symbols - Jamaica



The symbol on the left of Figure 6 indicates the availability of information. It is used extensively in the popular software programs from Microsoft called Windows and other programs using the Windows operating system. It is also used to identify places were information can be found. No one identified the symbol correctly. The most common response for it was No Response (63%).

The symbol on the right side of Figure 6 is again the 3.5 Inch Low Density Floppy Diskette. No one correctly identified it. The response selected by the Jamaican subjects was different than that chosen by the U.S. group. The most common Jamaican response was Unknown (41%).

Implications Of The Study

There are many implications that can be drawn from this study. For the researchers, what began as a study to determine if it was helpful to use symbols in presentations to an audiences having a different primary language, turned into a critical indictment of the usefulness of symbols in any presentation. Four major implications can be made from this study.

First, both the Jamaican and U.S. audiences differed in their interpretation of the majority of the symbols in the study. While the reader should be cautioned not to generalize these findings, it appears that the symbols employed in the current inquiry do not have the power of a written language or the spoken word. From this small study it is evident that people often mistake or do not know the meaning of many symbols. This research indicates that while symbols often provide a general meaning to an audience they can not be counted on to deliver a more specific meaning. Researchers have criticized inquires which attempt to test the ability of generic symbols to convey specific meanings. The specific meaning of a symbol must be deduced by first applying the generic concept implied by the symbol to a context specific referent[17]. Possibly, the symbol in the present study did not provide sufficient contextual cues for making inferences as to their specific meaning. Conceivably, the confusion over the traffic signs (Walking, School Crossing and Pedestrian Crossing) shown in Figure 5, suggests that a general understanding of the communication context was achieved, but not a specific understanding. Often we are not even blessed with a general understanding when symbols are used as shown in Figure 2. Surely the concepts of a glass of ice cubes and a trash can are worlds apart.

A second implication is that international audiences do not understand symbolic messages in the same manner as U.S audiences. As Pettersson points out, image perception is relative [18]. The Jamaican subjects used in this study did far worse on symbol identification than their U.S. counterparts. The symbol language was developed, in part, to help internationals better navigate in a different culture. However, symbols may confuse meaning. The researchers collected additional data from Thailand and although it was not included in this paper the results appear to be similar to the analysis of the Jamaicans. Thais misinterpreted many of the symbols used.

The third implication drawn from the data involves the kind of meaning we derive from symbols. Most subjects seem to make quick fixations and rapid judgments about pictures. Subjects do not spend much time looking at a symbol before they determine meaning. This may contribute to variability between symbol interpretations. For example, in the case of the floppy diskette in Figure 2, subjects did not notice the hole which would have identified the disk as a low density floppy diskette. Most subjects simply called the object by its more generic name, computer disk. In another example, the traffic symbols in Figure 5, many subjects did not notice the absence of crosswalk lines in the walking symbol and believed it designated some type of crosswalk symbol. These observations can lead one to speculate that for some symbols viewers employ a low level of perceptual processing and detailed processing does not occur[19]. The symbol is identified in a generic sense but image details are not noticed and therefore not processed. Symbols apparently have not developed all of the power of a written or spoken language.

The fourth implication of the data is that if symbols must be used, we should use only those that are commonly understood by all people. Of the symbols studied, some of the traffic and the no smoking signs were well recognized by the subjects in this study. When new symbols were introduced they were very difficult for the audience to identify. New symbols should be pilot tested before they are used on critical audiences. There is a need to effectively measure symbolic messages for comprehensibility and legibility[20].

Much more work needs to be done on the topic of symbol recognition. While the use of symbols appears to make business visuals more attractive and interesting, this study suggests that they do not necessarily enhance meaning. The use of symbols may even confuse the purpose of a visual. Additional research needs to be conducted to assess the reliability of symbols to enhance the meaning of visuals.

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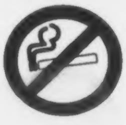
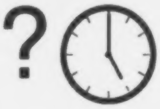
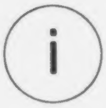
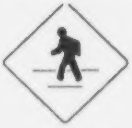
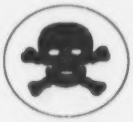
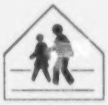
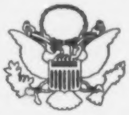
20. Dewar, R.E. and Ellis, J.G., pp. 183-189.

APPENDIX A

Symbol	Accepted Title	U.S. Difficulty Index	Jamaican Difficulty Index
	No Smoking	1.00	.96
	What time is it?	.70	.33
	Information	.35	.00
	Pedestrian Crossing	.16	.26
	Poison	.77	.30
	School Crossing	.63	.22
	United States	.40	.04

APPENDIX A (continued)

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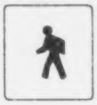
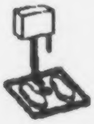
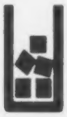
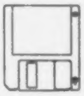
	Pedestrian Crossing/Cross Walk	.88	.67
©	Copyright	.26	.11
	Squat Toilet	.27	.11
	Glass With Ice Cubes	.00	.04
	3 1/2 inch Low Density Disk	.00	.00

The Effects of Redundant Visual, Auditory, and Tactile Stimuli on a Minimum Information Tracking Task

by
Steven C. Miller

Many everyday tasks involve the use of redundant stimuli. For example, when one is driving a car and runs off the road one feels the vibration from the wheels going over a rough surface, hears the sound of the tires hitting bumps, and sees the road in a position where it is not supposed to be. This event portrays a common example of redundant stimuli. That is, the feel and sound of a new surface and the sight of the road not being in the correct position are essentially providing the same information, that of not being on the road. From this example two main questions may be asked. Are redundant stimuli or signals beneficial in motor performance and how is redundant information initially processed? This study hopes to shed some light on these questions.

Common sense suggests that two sources of information would be better than one; however, in reality this is not always true. There has been a general observation that redundant bisensory stimuli improves or facilitates signal detection performance (Hopkins 1967; Grice, Canham, and Boroughs 1984) and response time (Colonius 1988). Other studies, especially involving tracking tasks, have produced results not completely supportive of this general observation. McGee and Christ (1971) hypothesized that tracking performance would be better when stimuli were presented in two modalities as opposed to one. In their study, a pursuit tracking display was used for the visual tracking alone condition. In addition, it was used in combination with one of two auditory conditions, either a white noise of 50 db. presented simultaneously with visual changes for 40 msec. or four separate tones which corresponded to four visual positions and equivalent duration and intensity to the white noise. Indeed, performance was facilitated with bimodal stimuli regarding measures of the proportion of long lags and integrated absolute error. Long lags were defined as reaction time delays of more than 150 msec. from the time of a target displacement and there were fewer occurrences of long lags with bimodal stimuli presentations. Integrated absolute error was analogous to the average distance away from the target measured through voltage differences which corresponded to the target and cursor positions. Although these measurements supported McGee's and Christ's hypothesis, spatial accuracy, measured to the nearest mm in terms of overshoots and undershoots and then averaged as a function of the trial number, showed no beneficial bimodal effects. The visual alone and visual plus tone conditions were determined equal and both were superior to the visual plus white noise condition. The results were considered in conclusive in that the addition of redundant auditory information can either inhibit or facilitate performance depending on situational aspects.

McCord (1989) also predicted a facilitation effect on the presentation of redundant auditory and visual stimuli in a compensatory tracking paradigm. Specifically, he predicted that a criterion level of performance would be achieved more quickly through stimuli presented bimodally than unimodally. McCord's visual stimulus was a cursor which varied in horizontal position and the auditory stimulus was 64 gradations in pitch spanning an approximately two octave range. Since no mention was made regarding auditory stimulus intensity, the assumption is made that the auditory intensity level remained constant. His bimodal condition was a combination of the auditory and visual stimuli. From the two dependent measurements, root mean square of cursor or tone movement and number of trials to meet the criterion level of performance, a synthetic variable was manufactured. This synthetic variable was labeled "general task difficulty" (p. 280). The best performance was observed when the visual modality functioned alone. This was interpreted in the light of task difficulty; in other words, the visual task alone was considered less difficult to control than either of the other two conditions. McCord concluded that the auditory stimulus was a distraction, actually hindering performance.

In summary, the evidence for redundant stimuli facilitation is inconclusive. Maybe Eriksen (1988) put it best when he stated, "we still do not know whether it would help if opportunity did knock twice" (p. 191).

This study looks at performance as it is affected by redundant stimuli presented in multimodal channels. Approaches examined by a review of the literature are the signal detection theory (Swets, Tanner, and Birdsall 1961) and separate activation and coactivation models (Miller 1982). These approaches have examined a variety of issues through different focal points. Specifically, this study used a minimum information tracking task to determine how performance is affected by unimodal, bimodal, and trimodal redundant stimuli.

A minimum information tracking task is one that only provides information about the error direction without information of the magnitude of the effort. For example, an auditory signal in the right ear would indicate that the error is to the right; therefore, error correction would require a deflection of the control device to the left. The intensity and the pitch would remain constant. Likewise, a constant vibrotactile stimulus to the right forearm or a light in the right visual field would indicate the same information.

The rationale for using a minimum information tracking task instead of response time or a compensatory tracking task is twofold. First, a tracking task requires more of a continuous action than response time. While tracking, subjects must continually monitor their sensory inputs and react when signals change or appear and disappear. Also, their reactions or joy stick manipulations, in this case, do not necessarily correct the error instantly as would be the case with a typical response time task. The intent is to make it necessary for information to be processed more continually, thus, increase the opportunity for error. This should magnify the effects the stimuli has on

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manual control and provide a clearer picture of how motor responses are affected by sensory information.

Secondly, a compensatory tracking task provides a representation of both the error direction and the error magnitude through one moving component (Roscoe, Corl, and Jensen 1981). Equivalent directional errors to the right and left are discrete and relatively easy to present through different sensory modalities. However, producing equivalent redundant signals for a continually changing error magnitude is much more difficult, especially when the speed of control manipulation is important, which is usually the case in tracking tasks. Error magnitude requires that a more continuous scale of information be presented. A specific distance presented visually will not naturally equate to an auditory tone altered by pitch or intensity. The same applies to tactile stimuli. Although not mentioned by McCord (1989), this problem may provide one possible explanation for the superiority of the unimodal visual stimuli over the bimodal auditory and visual stimuli in his 1989 study.

LITERATURE REVIEW

The evidence for performance improvements when redundant stimuli are presented is broad and widely varied. Simon and Overmyer (1984) demonstrated that redundant color (visual) and shape (visual) coding lead to quicker response times than single dimension color coding but not significantly faster than shape coding. Powers and Madison (1987) showed that kindergarten children who had speech production problems performed better in scores of discrimination skills after being instructed to attend to bimodal stimuli than those just presented with either auditory or bimodal stimuli. Also, bimodal stimuli produced better performance than auditory stimuli alone for the subjects not receiving the instructions. Melara, DeWitt-Rickards, and O'Brien (1989) produced evidence that correct eyewitness identifications could be improved if actual suspect lineups had both visual and auditory information, as opposed to the standard of just visual information. Finally, Doll and Hanna (1989) demonstrated a bimodal advantage in the signal-to-noise ratios necessary for signal detection in sonar displays. However, the following discussion focuses on two specific areas. They are the signal detection theory (Swets, Tanner, and Birdsall 1961) and separate activation and coactivation models (Miller 1982).

Signal Detection Theory

Signal detection theory provides one approach to the general perceptual capabilities of humans (Swets, Tanner, and Birdsall 1961). Hopkins (1966) applied the signal detection theory to the interaction of redundant information through more than one modality. After threshold detection levels were established for auditory and visual signals for two subjects, signals were presented separately and then simultaneously with specific probabilities of occurrence. Simultaneous signal presentation produced a "marked increase" in the probability of detection over the presentation of signals separately (p. 4). The explanation for this was the simple adding of probabilities. In other words, the auditory and visual modalities performed independently. The detection increase was attributed to the fact that the individual signals, auditory and visual, each had their own chance of one of them being detected was increased.

Loveless, Brebner, and Hamilton (1970) indicated that intersensory interactions may not be as simple. Although their main focus was also signal detection theory, their context was broadened to include difficult detections, recognitions, and discriminations. They addressed the possibility of specific modality interactions, not just the simple summation of probabilities. Even though increased bisensory efficiency was confirmed they were unable to establish any uniform strategies to link the rules regarding the integration of bisensory stimuli.

Separate Activation versus Coactivation

When performance is improved by the presentation of redundant signals it is called the redundant-signals effect (Kinchla 1974). There are two theoretical models that account for the redundant-signals effect (RSE). Raab (1962) used the term statistical facilitation, while Miller (1982) used the term separate activation to describe the first model. Here, redundant stimuli are considered separate and the one that is detected first is the one that is acted upon. Activation of a response must come from one signal acting separately and reaching a criterion level. In other words, reactions to equivalent simultaneous signals presented through different modalities will be responded to individually according to the signal that is sensed or perceived first. This is analogous to one signal or modality being faster than the other on a specific trial. On subsequent trials the other modality may produce a faster signal. Hence, the term "race" model has also been used to describe this hypothesis (Miller 1982; Grice et al and Colonius 1984).

The second model is called coactivation (Miller 1982). In this model the information in the stimuli are combined producing gains that result in response times even lower than those that could be produced by the separate activation model (Eriksen 1988). In Miller's description of coactivation the response to redundant signals would be influenced by both components working in a combined effort to satisfy the criteria necessary for a response.

Consider the scull, a light racing boat operated by one, two, or four oarsmen. Separate activation is analogous to having two separate sculls, each with one oarsman (individual modality signals) racing to a finish line (the criterion necessary for a response). The scull or signal that reaches the finish line first is the one that initiates a response. The one that finishes second has no effect for this particular race, but may finish first the next race. As a comparison, coactivation is analogous to two oarsmen in the same scull rowing in cooperation together to reach the finish line. The two oarsmen scull may produce times faster than is possible by a single oarsman scull.

In conclusion, the overall evidence seems to point to an enhanced performance when information is presented redundantly. Therefore, logic predicts that the same information presented through more than one modality should facilitate performance on the minimum information tracking task used in this study. In other words, the prediction here is that the trimodal condition will produce the best performance. Any bimodal condition will produce performances better than either of the individual elements from which it was composed. For example, the visual-auditory condition will produce a better performance than either the visual alone or the auditory alone condition.

METHOD

Subjects

The subjects for this study were 25 undergraduate 201 Psychology students, 14 males and 11 females. Three male subjects were eliminated from the study. Two were eliminated due to stated difficulties with the stimulus presentation and one was eliminated by random selection to produce a balanced experimental design of 11 males and 11 females.

Requirements for participation were that subjects have normal or corrected vision and no known hearing loss. Of the 22 subjects, 21 had normal or corrected vision in both eyes and all had no known hearing loss. One female subject had normal vision in one eye and 60:60 vision in the other eye. Because she reported no difficulty seeing the visual stimuli and her scores indicated no difficulty, her data were used.

All the subjects were from 18 to 21 years old. There were 20 right handed subjects and two left handed subjects. Each subject used their dominant hand to control the joy stick. Subjects received extra class credit for their participation and a chance to win a $25.00 cash prize.

Apparatus and Materials

A minimum information tracking task was presented by a Zenith 258 computer. The cursor disturbance function was computer generated mathematically by the summation of five sine waves having different frequencies. The visual signal was presented on a Zenith color computer monitor and consisted of a yellow box, one mm wide by two mm tall, placed on either the right or left side of a computer screen. The horizontal position of the visual signal was seven mm from the center of the screen to the box. The auditory signal was produced by a Radio Shack miniature piezo buzzer, number 273-074. It was powered by two C batteries and created a constant tome of 4.2 ± 0.5 kHz. A buzzer was mounted inside the right and left side of a set of head phones. To obtain a comfortable sound level, determined subjectively, it was necessary to muffle the buzzers.

The tactile signal was a vibrotactile stimulus presented on the back of either the right or left forearm. Placement of the display was midway between the elbow and the wrist. The vibrotactile displays were constructed from Radio Shack 1.5-3.0 volt DC motors, number 273-223. The shaft was unbalanced to create the vibration. The unbalanced motor was encased in PVC plumbing fittings and was mounted on an archery arm guard. The arm guard had adjustable elastic straps with velcro ends for securing it to the subject's forearm. A vibrotactile display was constructed for each forearm and powered by a three volt DC converter. Controlled by the computer, an external switching device was developed and used for the auditory and tactile signals.

All the signals were presented at an intensity above absolute threshold. When presented the signals remained active until the error was corrected to within tolerance standards, a space four mm wide centered in the middle of the computer screen. In other words, when the invisible cursor was more than two mm from the center of the screen a signal or signals, depending on the condition, was given to the side of the error. No stimulus meant the subject was on target and at no time were simultaneous signals given to both the right and left side.

The control devices were Measurement Systems 546 joy sticks mounted on the right and left arms of the subject's chair. All subjects used their dominant hand for tracking. A Scientific Solutions A/D board interfaced the joy sticks to the computer. Although the joy sticks allowed physical movement other than right and left, only the amount of right or left horizontal displacement effected the cursor. Determined by the displacement magnitude, the effect was progressively stronger the further the joy stick was moved from its center position.

Procedure

A verbal explanation of the tracking task was presented to each subject. In the explanation phase, a visual cursor was shown along with either the visual signal or the auditory signal to demonstrate how the cursor reacted under control of the joy stick. Since the subjects were not actually outfitted with the sensory displays during this phase, the tactile signal was not used in the demonstration. This was done to minimize distraction from the visual cursor. The cursor was visible only during this initial demonstration.

Each subject individually performed a minimum information tracking task presented in seven different conditions: (a) visual alone, (b) auditory alone, (c) tactile alone, (d) visual and auditory together, (e) visual and tactile together, (f) auditory and tactile together, and (g) visual, auditory, and tactile together. A dichotomous signal was presented on either the right or left side of the subject. A signal on the right meant that there was error to that side and a correction move to the left was needed. A signal to the left meant the opposite. Each subject performed one set of one minute practice trials on each different condition. A record of the practice set was kept, but was not used in the analysis. The order of conditions in the practice set was maintained in each subject's first respective experimental set. Subjects then performed six additional sets of one minute experimental trials for each condition. A counterbalanced design was employed to minimize the risk of any practice effects.

Measurements were taken by the computer and consisted of root mean square error. Root mean square (RMS) error is a measurement of error magnitude and is analogous to the average deviation from the target.

Note that during the auditory alone and the visual-auditory conditions the computer malfunctioned sporadically beginning with subject number eight. The signal would get stuck, usually on the left side, and the joy stick had no control during this period of time. Every malfunction was aborted and immediately restarted and they became more numerous for the last five subjects. After initial exposure to the malfunction, the subject was given the explanation that the system had a bug in the auditory alone and the visual-auditory conditions. Starting with subject number 22 an explanation of the malfunction being possible was given during the initial instruction process prior to any occurrence of the malfunction.

Of the 22 subjects whose data was used, the auditory alone condition malfunctioned a total of 15 times out of the 154 presentations of that condition, including three times in practice trial sets and twelve times in experimental sets. The visual-auditory condition malfunctioned a total of 18 times out of its

154 presentations, including two times in practice trials and sixteen times in experimental sets. The malfunctions created no obvious effect on performance.

RESULTS

A 7 (Information Conditions) X 6 (Trial) X 2 (Gender) analysis of variance (ANOVA) with repeated measures was performed on RMS error scores. The independent variables were information conditions (within), trial (within), and gender (between). The dependent variable was root mean square error. Due to insufficient error degrees of freedom in the & X 6 X 2 design, a univariate F test for gender effects was performed by collapsing across conditions and using the condition means for each subject. Possible moderating variables, which were controlled were age and handedness. Both age and handedness were controlled by the random assignment of subjects to a prearranged sequence of trials. Age was also controlled by the selection of undergraduate Introduction to Psychology students, while an added control for handedness was having each subject use his or her dominant hand to control the joy stick.

A significant main effect was found for information condition, Wilk's Criterion F (6,15) = 8.21, P = 0.0005. No main effects were found for gender, F(1,20) = 1.76, p = 0.1999. No effects were found for either trial, the condition by gender interaction, or the trial by gender interaction. The significant main effect for information condition allowed for four a priori comparisons to be executed. A priori comparison is a comparison formulated to directly test predicted hypotheses before the actual experiment is conducted (Christensen and Stoup 1991). Using Wilk's Criterion, each dual modality condition was compared with the best performing single modality condition that was used to construct its combination of conditions. For example, the visual-auditory condition was compared to the visual alone condition because the visual alone condition had the lower mean RMS error score than the auditory alone condition. Likewise, the trimodal condition was compared with the condition that produced the best performance other than itself. The logic for applying this technique to determine the specific a priori comparisons was appropriate because it insured a conservative test of the null hypothesis if the direction of the mean differences was as predicted (redundant signals effect) and a liberal null hypothesis test if the direction of the mean differences was not as predicted (interference effect).

Specifically, the visual-auditory and visual-tactile conditions were compared with the visual alone condition. The auditory-tactile condition was compared with the auditory alone condition and the visual-auditory-tactile condition was compared to the visual-auditory condition. No significant effects were found for any of the a priori comparisons.

The standard deviations represented a large amount of between subjects error. To examine the position of the means without this error a sign test was used. The trimodal condition and each bimodal condition were compared with each element or combination of elements that were used in its construction. The sign test was significant, X = 11, N = 12, at p<.01. X represents the number of means in the predicted position, while N represents the total number of comparisons tested.

Since the position of the condition means was as predicted, except for the visual alone condition, an additional analysis was performed to explore the possibility of making the distinction between separate activation and coactivation. A 7 (Information Conditions) X 2 (Gender) ANOVA with repeated measures was performed using the fastest (best) performances for each subject in each condition. There was a significant main effect for information condition, Wilk's Criterion F(6,15) = 6.92, P = 0.0011. Again, no main effect was found for gender using Wilk's Criterion, F(7,14) = 1.46, p = 0.2591 or for the condition by gender interaction, Wilk's Criterion F(6,15) = 1.82, p = 0.1617. Four a priori comparisons were executed, using the same pairs of conditions used in the previous analyses. No significant effects were found for these comparisons.

A sign test was also performed on best performance means and was significant, X = 12, N = 12, at p<.01. Again, each combination of conditions was compared to all the possible elemental conditions that could have been used in its construction.

DISCUSSION

It was predicted that the trimodal condition would produce the best performance, while each bimodal condition would produce a better performance than their respective elements of construction. These predictions were not supported by the ANOVA and a priori comparison data for either the overall performances or the fastest performances. however, there was no evidence to support the distraction explanation provided by McCord (1989).

In his study, McCord (1989) credited the lack of bimodal facilitation to distraction. in other words, during the bimodal condition, the auditory task distracted or interfered with the visual information. However, simple interference or distraction doesn't appear to be an accurate explanation for this study's results. Using McCord's explanation, it would be logical to conclude that more non visual information presented with visual information should produce more interference. The trimodal condition should have then produced more interference with visual information than the bimodal conditions with a visual element. in other words. the trimodal condition should have produced more of a decrement in performance than the bimodal visual conditions. This was not the case. Statistically, there was no difference between the visual alone condition, the bimodal conditions containing a visual element, or the trimodal condition.

Even though the ANOVA and a priori analyses did not support the RSE position, the sign tests did provide evidence on its behalf. The sign test for the all-inclusive performances demonstrated that the positions of the conditions were as predicted with one exception. the visual alone condition performed better than the visual-tactile condition. In other words, all the condition means were as predicted except for the visual alone condition. The sign test for the fastest performances was as predicted, without exception. This evidence supports the RSE hypothesis, in other words, conditions with more redundant information generally performed better than conditions with less redundant information.

The evidence supporting the RSE logically supports the separate activation hypothesis also. This deduction is justified any time the positions of the conditions containing more redundant stimuli is superior to the conditions containing less redundant stimuli. In other words, any of the individual sensory modalities could provide the signal that is acted upon during any given race (win the race). Summing the faster individual signals through a set of trials would produce an overall performance better than the individual signals acting alone. However, what is lacking is evidence supporting the coactivation hypothesis. This would have taken performances that couldn't have been explained by the separate activation hypothesis. In other words, the best performances of the conditions containing redundant stimuli would have to be superior by enough magnitude that they could not be explained by the separate activation hypothesis. Another way of explaining it is that at least the top percentage of conditions having redundant stimuli would have top be better than those produced by the best possible individual performances. Evidence to support the coactivation model was not produced by this study.

One question that must be addressed is, why did vision generally appear superior to the other unimodal conditions and the visual-tactile conditions when the overall performances were used? Several explanations are possible. One is that people are more practiced when it comes to visual tracking. People drive cars, play video games, or play tennis, etc. as everyday activities, thus, through the practice of motor control while using visual stimuli, a high skill level has been developed. Another possible explanation, was provided by McCord (1989). he indicated that visual tasks may be more natural for humans due to "more readily available structures for visual-motor control" (p. 281).

Another explanation related to the latter is the principle of S-C-R compatibility (Wickens, Sandry, and Vidulich 1983). S-C-R stands for stimulus-central processing-response. The principle is based on the natural mapping between stimulus and response. Specifically, the principle states that auditory stimuli are more compatible to speech responses, while visual stimuli are more compatible with manual responses. Since the response in this tracking task was manual, the S-C-R principle would predict a visual superiority. This was supported by the data.

This was the first time a minimum information tracking task had been used. Although a decision at this time on its worth as a tool in this type of research would be premature, the fact that no interference effects surfaced reflects positively on the task itself.

The equality of different modality signals is an appropriate concern for redundant stimuli research. This was a primary focus in this study. The poorest performance came from the tactile alone condition, therefore, it is appropriate to assume that the tactile signal alone was not equivalent to the other unimodal signals. This could be due to a servo motor delay in the mechanics of the vibrotactile display during the starting and stopping of the motor. It could also be due to the afferent nerve structure or to central processing. However, a combination of factors is probably the most likely. Since it is not possible to change the afferent or central processing structures of subjects, modifications to make the tactile display equivalent to the visual and auditory displays would be appropriate for future research. There are two obvious approaches. One is to redesign the vibrotactile display. The display that was used in this study used a very small motor. Although difficult to detect directly, the extra weight used to unbalance the shaft may have been enough to delay the starting and stopping of the motor adversely affecting performance. An oscillating motion, like a buzzer or bell uses, instead of a rotary motion may lessen the effects of inertia that must be overcome in any mechanical device. Another approach is to alter the timing of signal presentation to compensate for the delay.

The lack of significant differences between conditions is attributable partially to large individual differences. However, it may also be attributable, at least in part, to the attempt to make direct measurements while performing a single task. By itself the task may not be sufficiently difficult to demonstrate the real effects of information conditions because the overall performances may be asymptotic. In other words, the performances are at a level that can't be improved upon, rendering a direct measurement insufficient to determine any differences. Future research using the minimum information tracking task may find it necessary to increased the task difficulty, thus increasing the mental workload (Wickens 1979). Ways to approach this are to make the task more difficult or use a secondary task performed simultaneously with tracking. under higher levels of workload, the effects of stimulus modality may be more pronounced.

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The Effects of a Color Code Used in Graphics on the Recall of Verbal Material

by
Peggy A. P. Pruisner

Introduction

"It is impossible to say how first the idea entered my brain; but once conceived, it haunted me day and night."

These words of the possessed main character in Edgar Allan Poe's "The Tell Tale Heart" seem appropriate for those of us who find a compelling area of study or avenue for research. They seem particularly poignant for those researchers driven by the questions surrounding the role of color in learning as Curtiss (1987, p. 35) states, "Color is the sensation aroused in one's mind." This haunting passion has led to a continuing line of research.

The initial study (Pruisner, 1992), "The Effects of the Use of a Color Code in Graphic Presentation and Assessment on the Reader's Immediate Recall and Delayed Retention," evolved from the researcher's concern for the increasing requirements of literacy (Venezky, 1990) that are necessary for the reader to make sense of the world. Among those requirements, visual literacy, the ability to understand and make visual messages (Dondis, 1973), is an integral part of the reading process that enables a contemporary learner to successfully interpret the broadening context of our information environment. Also of concern are the potential for and reluctance of educators to manipulate and interact with the features or characteristics of graphics and to consider instruction aimed at developing visual literacy as essential across the curriculum (Robinson, 1991).

Color, one of the most significant and perhaps interesting features of text with the potential to be manipulated to the reader's advantage, is among the least understood, supported by contradictory and confusing research. Evolving from noteworthy, classic studies where color was coded in graphic study materials (Dwyer and Lamberski, 1982-83), the continuing study into the manipulation of color to enhance learning in an increasingly complex information environment is worthwhile. This second study attempts to further isolate color as applied to learning from graphics by eliminating the oral retelling of the myth used prior to the reading of the myth and accompanying graphic in the first study.

Methodology

Statement of the Problem

In response to the contemporary reader's need to interpret graphics in our broad information environment, research stresses the need for and importance of well-designed graphics (Gerber, 1985; Kostelnick, 1988; Peterson, 1983). Empirical research needs to be conducted to determine the effects of the manipulation of graphic features on reading (Hartley, 1986), graphical comprehension (Peterson, 1983; Soderston, 1983), and instruction.

Research Questions

The following research questions were investigated in both the initial research and this subsequent study:

1. Is there a significant interaction among the graphic presentation type (systematically color-coded or black/white), the graphic assessment type (systematically color-coded or black/white), and the time of testing (immediate recall or delayed retention) of verbal material?
2. Is there a significant interaction between the graphic presentation type (systematically color-coded or black/white) and the graphic assessment type (systematically color-coded or black/white) when immediate recall of verbal material is tested?
3. Is there a significant interaction between the graphic presentation type (systematically color-coded or black/white) and the graphic assessment type (systematically color-coded or black/white) when delayed retention of verbal material is tested?
4. Is there a significant difference in recall of verbal material between those given a systematically color-coded graphic presentation and those given a black/white graphic presentation?
5. Is there a significant difference in retention of verbal material between those given a systematically color-coded graphic presentation and those given a black/white graphic presentation?
6. Is there a significant difference in recall of verbal material between those given a systematically color-coded graphic assessment and those given a black/white graphic assessment?
7. Is there a significant difference in retention of verbal material between those given a systematically color-coded graphic assessment and those given a black/white graphic assessment?

Research Design

An analysis of variance for repeated measures was used to test the hypotheses that significant interactions and differences would occur. The independent variables manipulated were the type of graphic presentation, the type of graphic assessment, and time of testing. The two presentation and assessment types were systematically color-coded and black/white, and the two times of testing included immediate recall and 2-week delayed retention. The dependent variable, recall/retention on the assessment graphic, was measured by achievement, the number of characters, actions, and explanations that were remembered and recorded as stated on a graphic presentation summarizing a little-known Norse myth. To accommodate three independent variables, with two levels each, a 2x2x2 (presentation x assessment x time of testing) was used. Presentation type and assessment type were the between-subjects factors, and recall/retention was the within-subjects factor.

Subjects

The entire seventh-grade class from a Midwest junior high school with 641 students in grades 7-9 was used in this study. The nine seventh-grade homerooms, containing a total of 215 students, were randomly assigned to one of four treatment groups (adjusted $\underline{n} = 30$).

Treatment Groups

The four treatment groups received the following:

1. Color-coded presentation, color-coded assessment
2. Color-coded presentation, black/white assessment
3. Black/white presentation, color-coded assessment
4. Black/white presentation, black/white assessment.

Procedure

During their homeroom session, all students received directions via audiotape; they then read and studied the graphic presentation in isolation. Finally, they demonstrated both immediate recall and 2-week delayed retention on the graphic assessment without the aid of the presentation graphic.

Materials

Following the directions, subjects were given the presentation graphic. The graphic design was the same on all presentations and assessments. The form of the graphic was a unique design created by the researcher to prevent the subjects from having prior experience with the graphic. The systematic color code was explained to all subjects who received color presentations and was selected to create a pattern in the reader's mind.

Scoring of the instrument

All assessments were scored by two raters to ensure accuracy. One point was given for each correct word or acceptable synonym. One point was given for each box or area where all words were written in order and spelled correctly. One point was given for each word or phrase that was placed in the correct box or area.

Results

Based on the results of the analysis of variance with the level of significance established at the .05 level, there was not a significant three-way interaction among the graphic presentation and the graphic assessment and the time of testing (see Table 1). The supporting evidence, the means and standard deviations for the four treatment groups, is graphically displayed in Table 2.

Table 1.

Repeated Measures Analysis of Variance, MANOVA Test Criteria and Exact F Statistics

	Value	F	Prob.	Sig.
Time x presentation	.99	.18	.67	NS
Time x assessment	.99	.94	.33	NS
Time x presentation x assessment	.99	.52	.47	NS

Table 2.

Mean Performance at Recall and Retention for Each Treatment Group

Group	Time of Testing			
	Recall		Retention	
	M	SD	M	SD
Color presentation				
Color assessment	58.70	(14.60)	25.13	(15.72)
Black/white assessment	48.40	(18.74)	19.43	(15.44)
Black/white presentation				
Color assessment	45.20	(17.79)	12.43	(12.00)
Black/white assessment	48.23	(16.00)	16.13	(17.51)

Note. n = 30 for each group

The analysis of between subjects effects indicated the presence of a significant two-way interaction between graphic presentation type and graphic assessment type. Also, presentation alone was the significant factor (see Table 3).

Table 3.

Analysis of Variance, Tests of Hypotheses for Between Subjects Effects

Source of of variation	df	Sum of squares	Mean square	Prob.	F	Sig.
Presentation	1	3300.42	3300.42	8.10	.01	SIG
Assessment	1	322.02	322.02	.78	.38	NS
Presentation x Assessment	1	1938.02	1938.02	4.76	.03	SIG

By reviewing the mean performance at recall and retention as a function of the type of presentation graphic, it can be determined that the preferred presentation type was color-coded (see Table 4).

Table 4.

Mean Performance at Recall and Retention as a Function of Type of Presentation Graphic

	Presentation Type	
	Color	Black/white
Recall	53.55	46.72
Retention	22.28	14.28

Note. n = 60 for each group.

Consequently, there was one major finding of this study: the important factor in enhancing performance appeared to be the presence of a systematic color code in graphic presentation. The combination of color presentation and color assessment produced the best performance of all combinations.

Recommendations for Practice

Because the use of color had an impact on the recall of verbal information presented in graphic form, the use of color in graphics should be considered when developing curriculum, planning instruction, and designing text. Designers, teachers, and students must let the purpose of the graphic determine the color code. The code should be thoughtfully created to enhance and extend schema development and fully explained to facilitate learning and retention of verbal material and thereby promote literacy.

Implications for Future Research

To continue this line of research, it is recommended that future study focus on color and graphics:

1. Research should be conducted to investigate how skilled readers use color to remember patterns in schemata. This research should include quantitative research, qualitative ethnographic research, and case studies of readers considered to be at an expert level. The results would have implications for the graphic schema strategies we teach to students.

2. Research should include the use of a color code in other graphic presentations and assessments to see if similar results are produced using a variety of both new and familiar graphic presentations and assessments.

3. Research should include experimentation with both cuing and systematic coding using different colors and varying numbers of colors in graphic background and print to see what impact these variables have on immediate recall and delayed retention.

4. Finally, there should be further research into the other features of graphic presentation and assessment to determine the comparative efficacy of other graphic features in tapping and developing schemata. This research should indicate whether other features in the graphic design are effective in producing increased immediate recall and delayed retention of verbal material presented in graphic form. The results of further research would provide valuable information for readers, teachers, and designers of curricular materials at all levels of the learning spectrum.

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Effects of Two-Way Visual Contact on Verbal Interaction During Face-to-Face and Teleconferenced Instruction

by
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Rationale

Traditionally, audio teleconferencing has been a convenient method of bringing students together for distance learning (Wagner & Reddy, 1989). In addition to audio teleconferencing, some colleges and universities have been experimenting with more sophisticated technologies that incorporate computer graphics (audio graphic teleconferencing), full motion video distributed via satellite, cable, or microwave, and other less costly audio/video teleconferencing systems such as slow-scan or compressed video (Ritchie & Newby, 1989; Wagner & Reddy, 1989).

Developers of more sophisticated teleconferencing systems claim that these systems are superior to the traditional audioconferencing systems because they offer the added benefit of *visual* contact among students and instructors which promotes interaction (dialogue) during instruction. However, there are few research studies that have actually studied interaction during teleconferences. The purpose of this study was to determine whether two-way visual contact between an instructor and students would promote dialogue during teleconferenced instruction. Furthermore, researchers wanted to study the specific types of verbal interactions that might be affected by the addition of two-way video contact. For example, would students ask more questions if they could see the instructor? If so, what types of questions would they ask? Would the types of responses given by students differ if two-way video contact was available during teleconferenced instruction? How would they differ from responses given during audio teleconferencing where there was no visual contact between the instructor and the students? These are some of the questions that researchers investigated in this experiment.

Problem

Researchers investigated whether there was a difference in either the overall frequency or the frequency of specific types of student verbal interactions among the following three groups: **Group A,** teleconferenced instruction where students had only two-way audio contact with the instructor; **Group B,** teleconferenced instruction where students had two-way audio and video contact with the instructor; **Group C,** traditional face-to-face instruction.

Hypotheses

Fifteen hypotheses were formulated based on the research question. The first hypothesis stated that the total number of student responses in the two-way audio-only group (Group A) would be significantly less than the number of responses given by students in the two-way audio/video group (Group B). Similarly, the second hypothesis predicted that the number of student responses in the two-way audio-only group, (Group A) would be significantly less than the number of responses given by students in the traditional face-to-face group (Group C). The third hypothesis predicted that students in the two-way video group (Group B) would give fewer responses than students in the traditional face-to-face group (Group C). In equation form the first three hypotheses were as follows:

Total number of Student Interactions Given During Instruction

1. **Group A < Group B**
2. **Group A < Group C**
3. **Group B < Group C**

The next three hypotheses dealt with a specific type of interaction called "Restricted Thinking Questions" which was defined as, "Request for responses that have an accepted, predetermined correct answer; factual knowledge or simple recall; lower levels of cognition" (Ober, Bentley, & Miller, 1971, p. 88). Again, hypothesis four predicted that students in the audio-only group would give fewer of these types of responses than students in the audio/video group. In equation form, Hypotheses 4-6 were:

Restricted Thinking Questions Asked During Instruction

4. **Group A < Group B**
5. **Group A < Group C**
6. **Group B < Group C**

Hypotheses 7-9 concerned another category of interaction called "Expanded Thinking Questions" which was defined as, "Request for information that involves open-ended responses, generation and application of principles, concepts, and generalizations; solutions generated by applications of rules or procedures; answers to how, why, what do you think; higher levels of cognition" (Ober, Bentley, & Miller, 1971, p. 88).

Expanded Thinking Questions Asked During Instruction

7. **Group A < Group B**
8. **Group A < Group C**
9. **Group B < Group C**

Hypotheses 10-12 concerned a category called "Restricted Thinking Responses" which was defined as, "Factual knowledge; an accepted or pre-determined correct answer; facts previously learned or easy to produce; lower levels of cognition" (Ober, Bentley, & Miller, 1971, p. 88).

Restricted Thinking Responses Given During Instruction

10. **Group A < Group B**
11. **Group A < Group C**
12. **Group B < Group C**

The final category of verbal interactions, "Expanded Thinking Responses," was defined as, "Open-ended responses; generation and application of rules or procedures; answers to how, why, what do you think; higher levels of cognition" (Ober, Bentley, & Miller, 1971, p. 88).

Expanded Thinking Responses Given During Instruction

13. **Group A < Group B**
14. **Group A < Group C**
15. **Group B < Group C**

Significance of the Problem

Most of the research in distance education consists of comparisons between traditional on-campus courses and their distance counterparts (Ritchie & Newby, 1989). Verbal interaction is rarely reported in these intermedia studies; in fact, student/teacher verbal interaction is often not permitted during instruction in order to avoid introducing an uncontrollable variable (Salomon & Clark, 1977),

Evidence suggests that students' perceived achievement and affect toward the subject and instructor are related to student/teacher interaction. When high levels of verbal interaction are present, students report that they learn more and enjoy the experience more than in situations that involve low levels of student/teacher interaction (Richmond, Gorham, & McCroskey, 1987; Gorham, 1988).

During audio teleconferences, nonverbal interaction is not transmitted between remote sites; however, during video teleconferences nonverbal information is transmitted. Research by Wiener and Mehrabian (1968) and Mehrabian (1971, 1972) suggests that some nonverbal information has the potential of inducing verbal interaction. Since verbal interaction is considered to be desirable during instruction, a case could be made for developing and utilizing distance delivery systems that provide optimum potential for two-way student/teacher interaction. In order to do so, such systems would require two-way video capabilities in order to transmit nonverbal information to remote sites. Institutions must be convinced that the benefits are worth the costs before investing in these resources. By measuring the benefits in terms of the potential for student/teacher interaction rather than exam scores and course grades, the benefits may, indeed, justify the costs.

Methods and Procedures

One-hundred seventy-two students enrolled in four separate sections of *Classroom Educational Technology* (ET 401) during the Fall Semester, 1991, at the University of Northern Colorado (UNC) took part in the study. All of the students were juniors or seniors pursuing teacher certification in Colorado.

Two-way audio /video teleconferencing facilities exist between two buildings, McKee Hall and Frazier Hall, on the UNC campus. The buildings are about one-half mile apart. The instructor taught from the Frazier Hall site while students met in the McKee Hall site. For the traditional face-to-face treatment, both the students and the instructor met in the McKee Hall site. Each site was equipped with 26" monitors plus all of the necessary hardware and software in order to operate either a two-way audio-only teleconference, or a two-way video teleconference.

Treatment Group A received instruction delivered via two-way audio-only teleconference. Students in this group could only hear the instructor. Treatment Group B received instruction delivered via two-way audio/video teleconference. Students in this group could both hear and see the instructor, and the instructor could both hear and see the students. Treatment Group C received instruction delivered in a traditional face-to-face manner. All groups received exactly the same instruction delivered by the same instructor.

Two lessons were delivered to each treatment group. The first lesson was used to desensitize the students to the newness of the instructional situation and no data were collected. Data were collected during the second lesson. The formats of the two lessons were similar. Students were given handouts followed by a short presentation by the instructor. A series of open-ended questions were then discussed. The instructor employed a standard wait time of five seconds after posing a question. If students did not respond, an additional call for responses was given before moving on to the next question. Instructional methods were consistent across all three treatment groups.

The instruction was videotaped and the videotapes were viewed and student questions and responses were coded according to the verbal interaction categories outlined in the Hypotheses. The reviewers awarded each student one point for each verbal response or question given in the appropriate interaction category. Figure 1 summarizes the treatment groups and Figure 2 summarizes the verbal interaction categories.

Figure 1. **Summary of Treatment Groups**

Treatment Group	Type of Treatment
A. Audio-only	**Two-wayaudio-only teleconferenced instruction**
B. Audio/video	**Two-way audio and video teleconferenced instruction**
C. Traditional	**Face-to-face instruction**

Figure 2.
Summary of Verbal Interaction Categories

1. **Total number of verbal interactions**
2. **Restricted thinking questions**
3. **Expanded thinking questions**
4. **Restricted thinking responses**
5. **Expanded thinking responses**

Results

A series of one-way ANOVA's and Dunn's t-tests were conducted for each of the verbal interaction categories to determine whether there were differences among the three treatment groups. The following tables summarize the results for each of the categories.

Table 1. ANOVA Summary Table for Total Number of Student Responses by Group and Dunn's Test

Source	df	SS	MS	F
Between Groups	2	270	135	9.09*
Within Groups	169	2510	15	
Total	171	2781		

(*p<.05)

Dunn's Post Hoc Test

Hypothesis	Group Comparison	Difference
1	A & B	0.0946
2	A & C	2.26216*
3	B & C	2.7163*

(*Significant at .05)

An F value of 9.09 indicated significance. A follow-up Dunn's t-test indicated that the difference was between the traditional and audio-only group and between the traditional and audio/video group. In both cases, students in the traditional group interacted more than students in the audio-only and the audio/video groups.

Table 2. ANOVA Summary Table for Restricted Thinking Questions by Group and Dunn's Test

Source	df	SS	MS	F
Between Groups	2	3.41	1.71	4.02*
Within Groups	169	71.81	0.42	
Total	171	75.23		

(*p<.05)

Dunn's Post Hoc Test

Hypothesis	Group Comparison	Difference
1	A & B	0.0111
2	A & C	0.2945
3	B & C	0.3056*

(*Significant at .05)

An F value of 4.02 indicated significance. A follow-up Dunn's t-test indicated that the difference was between the traditional and the audio/video group. Students in the traditional group asked more restricted thinking questions than students in the audio/video group.

Table 3. ANOVA Summary Table for Expanded Thinking Questions by Group and Dunn's Test

Source	df	SS	MS	F
Between Groups	2	5.71	2.86	3.37*
Within Groups	169	143.28	0.85	
Total	171	149.00		

(*p<.05)

Dunn's Post Hoc Test

Hypothesis	Group Comparison	Difference
1	A & B	0.1354
2	A & C	0.1386
3	B & C	0.4325*

(*Significant at .05)

An F value of 3.37 indicated significance. A follow-up Dunn's t-test indicated that the difference was between the traditional and the audio/video group. Students in the traditional group asked more expanded thinking questions than students in the audio/video group.

Table 4. ANOVA Summary Table for Restricted Thinking Responses by Group and Dunn's Test

Source	df	SS	MS	F
Between Groups	2	59.15	29.57	10.35*
Within Groups	169	482.97	2.86	
Total	171	542.12		

(*p<.05)

Dunn's Post Hoc Test

Hypothesis	Group Comparison	Difference
1	A & B	0.1039
2	A & C	1.1917*
3	B & C	1.2956*

(*Significant at .05)

An F value of 10.35 indicated significance. A follow-up Dunn's t-test indicated that the difference was between the traditional and the audio-only group and between the traditional and audio/video group. Students in the traditional group gave more restricted thinking responses than students in the audio-only and the audio/video group.

Table 5. ANOVA Summary Table for Expanded Thinking Responses by Group and Dunn's Test

Source	df	SS	MS	F
Between Groups	2	20.88	10.44	3.55*
Within Groups	169	496.77	2.94	
Total	171	517.65		

(*p<.05)

Dunn's Post Hoc Test

Hypothesis	Group Comparison	Difference
1	A & B	0.1180
2	A & C	0.8005*
3	B & C	0.6825

(*Significant at .05)

An F value of 3.55 indicated significance. A follow-up Dunn's t-test indicated that the difference was between the traditional and the audio-only group. Students in the traditional group gave more expanded thinking responses than students in the audio-only group.

Conclusions, Implications, and Recommendations

In general, two patterns emerged from this study. First, the audio-only and audio/video groups did not differ significantly in any of the verbal interaction categories. According to the literature on the Immediacy Principle (Wiener & Mehrabian, 1968; Mehrabian 1971, 1972), certain nonverbal immediacy behaviors should induce verbal interaction. Since the audio/video group had the added benefit of two-way visual contact with the instructor, researchers predicted that these immediacy behaviors would be transmitted to this group. Conversely, the audio-only would not be subjected to these immediacy behaviors. The result should have been that student verbal interaction in the audio/video group was significantly greater than student verbal interaction in the audio group if the Immediacy Principle held. The Immediacy Principle was the basis for Hypotheses 1, 4, 7, 10, and 13. In each of these researchers predicted that the audio/video group would interact significantly more than the audio-only group. Yet each of these hypotheses was rejected. The immediacy behaviors observed by the audio/video group did not result in a significant increase in student verbal interactions during instruction.

This phenomenon may be related to the passive nature of television viewing. Even though instruction was delivered live and there were two-way audio/video capabilities, students may have slipped into a passive viewing mode where their cognitive engagement waned during the instruction (Brown, 1988). Follow-up conversations with some of the participant yielded information that supports this thesis. Some students reported that they found it difficult to concentrate on the lesson when they were looking at a video image of the instructor. Several students said that they could only concentrate on the lesson when they were looking at the handouts or away from the video monitors. As a result, the nonverbal cues given by the instructor had little effect on the number of verbal interactions that took place during the lessons.

The implications of this finding on improving distance education are that if instructors want to take advantage of the added benefits of two-way video contact in order to maximize student participation, they must do more than focus the cameras on themselves during instruction. Further research could be conducted to determine how the video signal could best be utilized in order to maximize student participation.

The second general pattern that emerged was that the traditional group interacted significantly more than the audio-only and the audio/video groups in several of the verbal interaction categories. Hypotheses 2, 3, 6, 9, 11, 12, and 14 were all accepted. This finding was supported by the literature on the Immediacy Principle. The instructor's nonverbal cues in the traditional group did succeed in inducing student verbal responses. An additional research project could be designed to determine whether nonverbal cues such as hand gestures, smiles, and nods have the same effect in audio/video teleconferencing as they do in traditional face-to-face settings.

It is difficult to claim summarily that the different types of instructional delivery modes used in this experiment were solely responsible for the significant differences found in Hypotheses 2, 3, 6, 9, 11, 12 and 14. One of the limitations of this study was the fact that classrooms are complex social environments. Indeed, there were many events that took place during the audio-only and the audio/video teleconferences as well as during the traditional sessions that supported this notion. Such events do not appear in the quantitative data reported in this study. Nevertheless, this study was concerned with the effects of visual cues on verbal interaction during instruction delivered via three different modalities. The findings support the idea that students are likely to interact more when the instructor is physically present in the room with them. However, the addition of a video signal to an audio teleconferencing system in and of itself is not likely to increase student verbal interaction during teleconferenced instruction.

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Uses and Values of Prototypic Visual Images in High School Mathematics

by
Norma C. Presmeg

Introduction by way of a problem

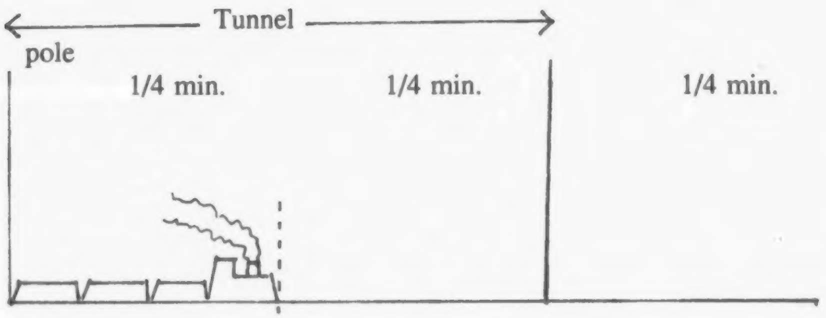
In mathematics at all levels and in all branches, some people would consider imagery of various types to be an essential component. This depends, of course, on what they consider imagery to be and on their definitions of mathematics. In the writer's research on imagery use in high school mathematics classrooms a definition was used which was deliberately broad enough to encompass imagery ranging from clear 'pictures in the mind' to vague spatial intuitions. A visual image was defined as "a mental scheme depicting visual or spatial information" (Presmeg, 1985, p. 90). This definition was never spelled out to the teachers and students in the research, because discussion of their imagery in context (in the course of several hundred transcribed interviews) enabled the researcher to interpret to some extent what they meant by the construct, 'image'. Of all the possible modalities, it was predominantly the visual one which assumed significance in these studies, although kinesthetic imagery was also reported occasionally and thus formed a category along with four other types of imagery (all visual).

By way of introduction to the uses and values of visual imagery in mathematics, consider the following problem (Krutetskii, 1976, p. 159).

A train passes a telegraph pole in 1/4 minute, and in 3/4 minute it passes completely through a tunnel 540 meters long. What is the train's speed in meters per minute and its length in meters?

(The reader might like to attempt the problem before reading on.)

This problem was included in the teachers' section of the writer's test for preference for visual modes of processing in mathematics, which was used to select mathematics teachers of various preferences, as well as visualizers in their classes, to participate in the research. Many teachers used algebra to solve the problem, often in a lengthy process. One teacher gave the elegant visual solution shown in figure 1, which speaks for itself.



After 1/4 minute train is in tunnel as shown in sketch.
Therefore length of train is 270 meters.
Speed of train is (270 x 4) = 1080 meters per minute.

Figure 1. Rough sketch. Teacher's solution to tunnel problem.

Notice that logical reasoning is also an integral part of this solution. Following Krutetskii (1976), the position was taken that all mathematics involves reasoning and logic. The visuality of a solution to a problem, then, was judged by the presence of a diagram or report of an image in the accompanying self-report questionnaire. As interviews demonstrated, there was tremendous variation in visual modes of processing throughout the studies. Imagery is certainly personal and idiosyncratic, and some forms may be considered more 'abstract' than others, as will be shown. In the case of the above problem and its visual solution, the writer displayed the statement of the problem and the diagram, with the artist's permission, at a talk given to a group of teachers. One member of the audience, who was in the research project, spoke rather scathingly in an interview later, as follows.

MRS GREEN (pseudonym): You know, it rather depends on what you mean by a visual image. An actual picture; well to my mind that thing with the train going into the tunnel and sticking half out of the tunnel and that ... to my mind [laughing] that was utterly ridiculous! It was quite un-necessary. I mean, I'd never dream of actually drawing the train.

I (interviewer): One could do a line.

MRS GREEN: I would put some sort of symbols, possibly, but I'd never get as far as that. My idea of an image is more or less a diagrammatic thing, and I like to show children, er, ... geometry lends itself to this kind of thing and of course algebraic problems and so on. I like to show them a sort of progression of steps. I very often give them a sort of summarized, mode of approach in problems; you know, translate from the words into algebraic symbols, analyzing each step of the information; that sort of thing. Now that, to my mind, is a visual image.

I: That is just as visual. Categorize and make a table [an aspect of MRS GREEN's teaching which had been observed on several occasions].

MRS GREEN: That's right. I tabulate, rather, and make diagrams rather than ... I mean actual little drawings of trains going into tunnels [laughs]; I haven't got time for that.

(Presmeg, 1985, p.220; "..." indicates pauses, not that segments of the interview are omitted.)

In this extract, MRS GREEN appears to be aware of a more abstract form of visuality which she attempted to convey in her teaching.

Images as mathematical prototypes

In the writer's initial three-year study of imagery in high school mathematics, the images used by the visualizers in the study were classified as follows. The numerals in parentheses indicate the numbers of students, of the 54 in the study, who used these kinds of images when solving high school mathematics problems in the interviews.

concrete, pictorial imagery	(52)
pattern imagery	(18)
memory images of formulae	(32)
kinaesthetic imagery	(16)
dynamic imagery	(2)

(Presmeg, 1985, p. 174).

Examples of all these categories have been published elsewhere (Presmeg, 1986a), and some instances of prototypic usages are illustrated below. Suffice it to say here that the difficulties which these visualizers experienced in their use of imagery and diagrams in mathematics were largely related to the one-case concreteness of the first category. A 'picture', whether external or internal, by its nature is a particular case, and this fact may prevent abstraction and generalization if the essential features cannot be separated from the random ones. But as Bartlett wrote in 1932, the disadvantages of use of imagery are but "the price of its peculiar excellences" (Bartlett, 1977, p. 220). By using imagery in prototypic ways which included metaphors and metonymies, the same features which presented potential difficulties were transmuted into strengths by some of the visualizers in the studies.

The essence of a *prototype* is that it is a mental representation which is a good example of a category (Lakoff, 1987, p. 43). In his extensive discussion of categorization theories, Lakoff described a radial structure in which the prototype lies at the center of a category. On the one hand, *metaphors* may be used to extend this structure or to link it with other categories through the identification of elements in disparate domains. On the other hand, *metonymies* are also valuable elements of categories, whether or not they are prototypic, i.e., at the center of the structure. Lakoff (1987, p. 79) defined a metonymy as,

> *"a situation in which some subcategory or member or submodel is used (often for some limited and immediate purpose) tocomprehend the category as a whole."*

Now, every time a diagram or a visual image is used effectively in mathematics, such a situation is brought into play, i.e., a metonymy is used.

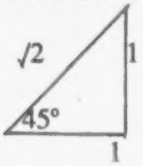
Illustrations

In all five categories of imagery metonymies could be identified, but their use was particularly striking in the cases of concrete images and memory images of formulae. All the following illustrations are from Presmeg (1985).

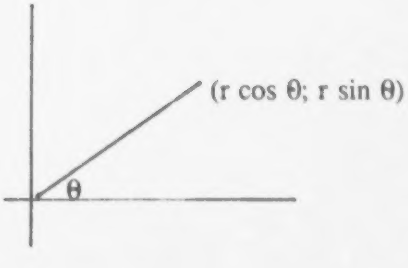
CARON W was a student who had particularly vivid visual images.

CARON W: Cosine 45 equals ... one over root two.
I: Now that looked as if you had a picture in your mind.
CARON W: Yeah, it was the triangle.
I: So you got a picture of the 45 degree triangle, and you can just read it from your image?
CARON W: Yeah.

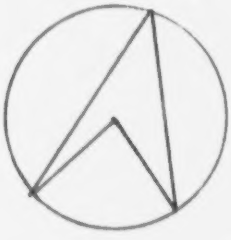
In common with many other visualizers, CARON could see the prototypic image represented as follows:



This instance is prototypic because it lies at the center in the radial structure of the category of all 45 degree right triangles. Another metonymic prototype in trigonometry was used by JENI D:



Standard diagrams of theorems in geometry often served the same function:



In the category of memory images of formulae, some formulae appeared to have a particular visual impact which facilitated the mnemonic use of an image, as in the following examples:

$$|AB| = \sqrt{x^2 + y^2}\ ; \qquad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}\ ;$$

$$x^2 - (\text{sum of roots})\ x + (\text{product of roots}) = 0.$$

The more vivid the image, the more facilitative it was of accurate recall. These concrete images ("I saw a page in my book" - CARON W) are metonymic in the sense that they frequently stand for an abstract procedure or principle which is recalled by means of the image.

Concrete imagery may also be used metaphorically, as in the following extract from an interview in which ALISON M was working with trigonometric ratios of angles in the four quadrants:

ALISON M: Then it would be sine ... second quadrant. So ... 180; you take it from 180, because that's your water level.

I: Oh, is that how you think of it? And how does the water level help you to get it?

ALISON M: Oh, um ... you've got ... It's like a ship sailing: can't sail that way really [up and down, i.e., y axis]. There, that, sort of ... it can. You work it from there. You take most of your ... 'cause that's your 360 ... it's there as well.

I: Did you think of that for yourself or did someone tell you about the water level?

ALISON M: No, I just thought of it.

ALISON's vivid and idiosyncratic imagery of a ship sailing and a water level was metaphorically used to remind her to use 180 degrees and 360 degrees, and not 90 degrees and 270 degrees, when calculating the acute angle she needed to find the trigonometric ratios. This is an instance of metaphoric use of concrete imagery. Kinesthetic imagery was also used in this way, for example in the case of several students who "walked" with their fingers to show four or five vectors head-to-tail when illustrating the concept of displacement for the researcher. A mixture of kinesthetic and dynamic imagery was used metaphorically by ISABEL M, who had sketched a linear graph after working out the coordinates of two points:

I: Would you normally have just two points, or would you work out a third one?

ISABEL M: Well you can work out a third one. MISS MAUVE [pseudonym] said that you can plot by two. If your points are close, then take a third one, because there's not so much movement, you know [illustrating with her hand the movement of the line in a see-saw motion]. If they're close, there's a lot of movement.

The implicit see-saw metaphor gave ISABEL the rationale for the number of points whose coordinates she calculated.

Some uses and values of various kinds of imagery used in metaphoric and metonymic ways have been illustrated. There is another type of imagery which is particularly important in mathematical reasoning and concept formation. These images were called by the writer, "pattern images", and by Johnson (1987), "image-schematic structures".

Pattern imagery

Reasoning, abstraction and generalization are necessary components of mathematical thought (Davis and Hersh, 1981). One way that imagery may be used in these processes is by making a concrete image the bearer of abstract information (Neisser, 1967), as illustrated in the foregoing metaphoric and metonymic usages. There is a second way, which is more difficult to illustrate because the images used are not like 'pictures'. An image itself may be sketchy and abstract; a method of working has a certain 'shape' to it which may be visualized (Arnheim, 1969). The type of imagery in which concrete details are disregarded and pure relationships are depicted in a visual-spatial scheme was designated *pattern imagery* in the writer's studies. These pattern images bear a striking resemblance to Johnson's *image-schematic structures*, which he described as mediating between images or objects of sensation, on the one hand, and abstract concepts, on the other (1987, p. 155). Johnson did not consider these structures to be images; but then, his definition of imagery appears to have been rather narrow, confined to what the writer would describe as *concrete imagery*.

The value of Johnson's account for mathematics education lies in the explicit recognition that "imagination", supported by image-schematic structures and used in a variety of ways including metaphors and metonymies, may be an integral part of the reasoning process itself. The writer's research provides some support for this position (Presmeg, 1992). Of the 54 visualizers in the initial study, only two, CRISPIN T and MARA L, consistently used more abstract forms of imagery, including pattern imagery. Both these students were in the classes of teachers who stressed the value of abstraction, generalization and recognition of patterns. MARA was in the mathematics class of MRS GREEN, whose comments on more abstract forms of imagery were quoted at the beginning of this paper in the context of the train problem. CRISPIN was in the class of MR BLUE, who stressed patterns and regularities in his teaching, although his mathematical problem solving style (as distinct from his teaching style) was singularly nonvisual. It is noteworthy that CRISPIN and MARA were the only two students in this study who achieved highly in their school-leaving mathematics examinations (Presmeg, 1986b). The attitudes which their mathematics teachers held towards the uses and values of imagery of various kinds apparently played a part in this achievement.

Teacher beliefs about imagery

The thirteen teachers in the initial study were arranged in three groups, i.e., visual, middle, and nonvisual, on the basis of their "teaching visuality", a construct which provided a ranking of the teachers in terms of their use of literature-based classroom aspects facilitating visual imagery. It may be noted in passing that *teaching visuality* was only weakly correlated with these teachers' *mathematical visuality*, i.e., the visuality of their mathematical problem solving styles (Spearman's r = 0.404, n.s.). For the present discussion, it is of relevance that the three groups of teachers held very different beliefs about imagery and its values in learning mathematics. Teachers in the visual group were unanimously positive about the visual methods which they employed in their classrooms, but they were seldom aware of the potential pitfalls (e.g., the one-case concreteness) of some kinds of imagery or graphic representations. In the nonvisual group, teachers typically avoided visual aspects as far as possible and consequently assigned little value to these. Visualizers in the classes of these teachers often came to distrust their own preferred visual methods of processing; only if they were able to relinquish their visual methods in favor of methods consonant with their teachers' could these students do (relatively) well. It was the teachers in the middle group, who used some visual aspects in their teaching but valued abstraction and generalization, whose students were able to use consistently, forms of imagery which overcame some of the potential limitations.

It is the writer's belief that increased awareness of different forms of imagery and their uses and values in the mathematics classroom would result in teaching which facilitated more effective use of this potentially powerful mode of learning mathematics.

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Perceptions of Between-Channel Redundancy in Television Messages

by
LuEtt Hanson

One of television's most salient characteristics is its ability to present information in two sensory channels simultaneously. Well-constructed dual-channel messages have great power to facilitate remembering and understanding, but poorly-constructed ones have great potential to confuse (Hartman, 1961b; Levie & Dickie, 1973).

Researchers concerned with discovering principles for sound informational television program design often ask: what is the best way to construct dual-channel messages to enhance learning? Their answers often involve the concept of between-channel redundancy--the presentation of messages with the same meaning in both channels simultaneously.

While most researchers agree on that general definition of redundancy, they differ on the number and nature of its varying degrees. Hartman (1961b) proposed four categories: redundant, related, unrelated and contradictory combinations of audio and video. Severin (1967) agreed with Hartman's first two categories, but split the third into "unrelated, same category" and "unrelated, different category." Conway (1968) criticized both proposals for making unnecessarily fine distinctions between categories of symbols that are actually "referentially equivalent."

In spite of this debate, however, some redundancy studies have continued to classify television messages simply as either redundant or not redundant. Examples of such studies include those by Pezdek and Stevens (1984), Reese (1984), and Drew and Grimes (1987). In a later study, Grimes (1989) proposed another category between the two extremes but failed to describe this category completely or consistently.

The lack of consensus on how to describe the relationship between the two channels of television messages is probably not limited to redundancy researchers. Eco (1982) and Graber (1989) have pointed out that interpretation of the meaning of a television program often differs from group to group among researchers, producers and audience members.

In order for researchers to accurately measure the effects of between-channel redundancy, and for TV producers to accurately provide the proper degree of redundancy in their programs, they must first be sure they understand how all three groups--researchers, producers and audience members--perceive redundancy. Many theorists of meaning and perception agree that a message's meaning depends on the receiver's interpretation (Littlejohn, 1978). Therefore, it is appropriate to have audience members and program producers evaluate the audio/video combinations described by redundancy researchers to see whether the three groups interpret between-channel relationships in the same way.

Audio/Video Combinations Described in the Literature

As noted above, many researchers have proposed differing categories of between-channel redundancy. Some of the researchers have merely described their categories in writing while others have created examples of television messages that fit their categories; few have actually tested their embodiments of varying degrees of redundancy against the perceptions of others.

Hartman (1961b), in his review of multi-channel research, proposed a model with four categories of redundancy:

"(a) Two channels may present *redundant* information such as the same word, printed and spoken. (b) Two channels may present *related* information such as a pictorial representation of an object and verbal description of the object. (c) Channel information--such as a picture of a tree in the pictorial channel and the word *nine* in the audio--may be *unrelated*. (d) The information presented may be *contradictory* as in the simultaneous presentation of the printed word, *woman*, and the spoken word, *man*" (p. 242).

There is no indication that Hartman ever realized these specific audio/video combinations on film or videotape. However, he did describe his creation and use of another similar film (Hartman, 1961a). This film presented people's faces with superimposed names and the sound of an announcer reading each name twice. The pictures, printed words and spoken words appeared in various combinations that seem to embody Hartman's redundant and related categories as well as a combination of the two, but he called the audio/video relationship by a different name--simultaneous information. Although Hartman (1961b) urged researchers to determine the relationship of information in the multiple channels of experimental stimuli operationally rather than subjectively, there is no indication he did this with his own categories.

Severin (1967) reported creating and using several combinations of audio and visual messages in a slide-tape format. The descriptions of his test conditions of "audio and print messages combined" and "audio with related pictures" match Hartman's redundant and related conditions respectively. However, Severin set up two kinds of unrelated categories:

> "Audio . . . with unrelated pictures of the same category (e.g., the word 'moose' with a picture of a bison) . . . .
>
> "The audio . . . with unrelated pictures of a different category (e.g., the word 'moose' with a picture of a catfish). . ." (p. 387).

The relationship between the sound and pictures in the second combination--unrelated, different category--is similar to the one Hartman described as unrelated, but the relationship in the first combination--unrelated, same category--seems to fall between those in Hartman's related and unrelated categories. Severin's categorization of multi-channel messages, like Hartman's, appears to have been done subjectively rather than operationally.

Warshaw (1978) studied attention to and learning from the dual-channel messages of television advertising. Although he was more interested in the amount of information in each channel than the nature of their relatedness, he did define one category of redundancy:

"The showing of similar but not identical material on two or more stimulus channels is herein defined as *incomplete redundancy* (e.g., word *animal* spoken while picture of a dog is shown on screen)" (p. 367).

This audio/video relationship is like Severin's unrelated, same category relationship. The pictures and sound are neither so close in meaning as those in Hartman's related category nor so different in meaning as the pictures and sound in his unrelated category. However, one of Warshaw's terms (animal) is inclusive of the other (dog), which is not the case with Severin's unrelated, same category terms (bison, moose). Since redundancy was not the focus of Warshaw's study, it is not surprising that he neither created this condition on tape nor obtained an objective assessment of the relationship of its elements.

Conway (1968) criticized both Hartman and Severin for confusing sense mode (seeing, hearing) with sign type (iconic, digital) in defining categories of redundancy. He said their distinctions between redundant and related messages ignored the possibility that many different forms of information can be "referentially equivalent" to an audience member. His example was the concept "cow," which he said could be evoked equally well by the iconic sound "moo," the spoken digital word "cow," an iconic line drawing of a cow, or the printed digital word "cow." According to Conway, any audio/video combination of those elements is equally similar in meaning. Conway mentioned creating and using different combinations of audio and video messages for experiments, but did not say whether his cow example was included. However, he reported pretesting to discover the referential equivalence of the different messages used in the presentations.

The preceding studies examined combinations of audio and video that are far simpler than those usually found in television programs. Some more recent studies have used actual TV programs or program-style material.

In their study of children's memory for auditory and visual information on television, Pezdek and Stevens (1984) used segments of *Sesame Street*:

> "The audio and video tracks from four different television segments were . . . combined to produce conditions in which (a) the audio and video tracks were from the same segment (A/V match), (b) the audio and video tracks were not from the same segment (A/V mismatch) . . . .
>
> "It is important to note that all of the A/V mismatch segments were arrived at by recombining audio and video portions of segments that involved the same characters. Although the voices and mouth movement were not synchronized, the voices and visible characters were the same" (p. 214).

Although Pezdek and Stevens did not use the term redundancy, their concerns about how people learn from multichannel presentations when the audio and video have different relationships of meaning are similar to the concerns of redundancy researchers. Their use of opposite terms (match, mismatch) for the relationships between the video and audio in their programs suggests that their categories are similar to Hartman's redundant and contradictory categories, even though Hartman's descriptions of the audio/video relationships in those categories differed from the descriptions given by Pezdek and Stevens. Pezdek and Stevens did not report any evaluation of the programs for matching or mismatching meaning; apparently they assumed that professionally created television programs have matching audio and video and that putting audio from one segment with video from another creates a mismatch.

Reese (1984) used television news programs as the vehicle for studying the effects of redundancy on learning. He defined redundancy as "shared information, such that there are facilitative and not contradictory relationships between words and pictures" (p. 80). His programs consisted of news stories with either redundant or nonredundant pictures and words. Reese described at length his validity test in which judges rated the relationship of the audio and video in the programs on a scale of +10 for redundant or reinforcing meaning to -10 for nonredundant or contradictory meaning. Reese's use of opposite terms (redundant, nonredundant) and his use of the terms nonredundant and contradictory interchangeably imply that his categories are similar to Hartman's redundant and contradictory categories.

Like Reese, Drew and Grimes (1987) used television news content to study the effects of varying conditions of redundancy on learning. The construction of their programs and their use of the terms redundant and nonredundant are similar to Reese's. However, Drew and Grimes did not report any objective testing of the nature of the audio/video relationships in their programs.

In an effort to clarify the findings of earlier studies (Reese, 1984; Drew & Grimes, 1987), Grimes (1989) added a category to previous either/or classifications of material as redundant or nonredundant. He described this condition as one "that exhibits overall *between-channel* redundancy and *between-message* conflict" (p. 2), and provided further explanation of the condition:

> "This is one in which the two information channels are thematically related, but one in which individual audio and video messages conflict. For example, such a condition might be one in which the narration refers to a collapsed house among a row of houses. But the accompanying video does not show *the* collapsed house. So when a reference is made to the collapsed row house, the video conflicts by showing a row of houses that are not collapsed" (pp. 2-3).

Although other examples in his paper muddy the issue, Grimes was obviously working toward establishing a category in which the audio/video meanings are neither so close as in Hartman's redundant and related categories nor so distant as in Hartman's unrelated and contradictory categories. Grimes' category is therefore similar to Severin's (1967) unrelated, same category relationship and Warshaw's (1978) incomplete redundancy relationship.

Grimes called the condition with the highest degree of redundancy "match/specific," the condition with partial redundancy "match/general," and the condition with extreme channel conflict "mismatch." He reported creating and using programs demonstrating these conditions. He also reported that TV news professionals evaluated the programs "to determine whether each of the stories was suitable for airing" (p. 11), but it is not clear how much that evaluation depended on an assessment of redundant meaning in the audio and video channels.

After more than thirty years of research, classification of audio/video redundancy relationships is still idiosyncratic. There is little consistency among the redundancy relationships described in the literature. Some researchers have appeared to draw overly fine distinctions between audio/video relationships while others have used too few categories for meaningful classification. There is little agreement about the boundaries or even the names of those categories.

Although television messages may be so complex as to defy precise classification, a common language of redundancy would be helpful for communicating research results and production guidelines clearly. Such a language should take into account audience's and producers' interpretations of audio/video relationships as well as those of researchers. This study compares researchers' descriptions of audio/video combinations with audience members' and producers' interpretations of those combinations in order to discover common grounds of understanding among those groups.

Methods

The stimulus in this study was a videotape consisting of 15 short (5-20 seconds) programs displaying various conditions of redundancy as described in the literature. Some of the programs were realizations of dual-channel presentations merely proposed in the literature, and the rest were recreations of programs actually used in previous studies. A complete description of the programs appears in Table 1. The programs were arranged in random order on the tape to reduce the possibility that subject responses would be affected by perceived patterns among the programs.

A pilot study was conducted in late April, 1991, with 47 undergraduate students in an Introduction to Mass Communication class. The students rated each program on a Likert scale on which 1 represented audio and video messages with the same meaning and 5 represented audio and video messages with opposite meanings. The mean ratings for programs presenting Hartman's and Severin's redundant and related categories and Hartman's simultaneous information category were 1.40, 1.32 and 1.77 respectively. Programs presenting Hartman's unrelated and contradictory categories were rated 4.66 and 4.83. Programs presenting Severin's unrelated, same category and unrelated, different category conditions were rated 3.74 and 4.45, while the program presenting Warshaw's incomplete redundancy condition was rated 1.87. These results suggest there are varying redundancy relationships and that viewers can distinguish among them.

In the present study, 109 undergraduate students in an Introduction to Mass Communication class and 21 professional TV production personnel viewed the videotape and rated each program on four semantic differential scales. Hartman (1961b) proposed the semantic differential technique as a way of defining the relationship between simultaneously presented audio and video information. The polar opposites on each scale in this study were chosen from among the terms researchers used to describe dual-channel relationships. The polar opposites were: same/ opposite, match/mismatch, related/ unrelated, and reinforcing/contradictory. Each scale was divided into seven positions, scored from +3 to -3. The instructions and subject response forms were adapted from models in Osgood, Suci, and Tannenbaum (1957).

Results and Discussion

Audience perceptions of the relationships between the audio and video channels in the stimulus programs were congruent with the researchers' perceptions on all but two programs. Table 2 shows the frequency of responses to each program on relevant scales and comparisons to expected frequencies. Relevant scales are those which use the researchers' exact relationship labels or the labels most similar to those used by

Table 1
Description of Programs

Program 1
Video: printed word "chair"
Audio: spoken word "chair"
Illustrates: Hartman's redundant condition, Severin's redundant condition, Conway's referentially equivalent digital video with digital audio

Program 2
Video: video shot of a cup
Audio: spoken word "cup"
Illustrates: Hartman's related condition, Severin's related condition, Conway's referentially equivalent iconic video with digital audio

Program 3
Video: still picture of a tree
Audio: spoken word "nine"
Illustrates: Hartman's unrelated condition

Program 4
Video: printed word "woman"
Audio: spoken word "man"
Illustrates: Hartman's contradictory condition

Program 5
Video: still picture of a bison
Audio: spoken word "moose"
Illustrates: Severin's unrelated, same category condition

Program 6
Video: still picture of an angelfish
Audio: spoken word "moose"
Illustrates: Severin's unrelated, different category condition

Program 7
Video: still picture of a dog
Audio: spoken word "animal"
Illustrates: Warshaw's incomplete redundancy condition

Program 8
Video: line drawing of a cow
Audio: sound effect "moo"
Illustrates: Conway's referentially equivalent iconic video with iconic audio

Program 9
Video: printed word "cow"
Audio: sound effect "moo"
Illustrates: Conway's referentially equivalent digital video with iconic audio

Program 10
Video: person's face with superimposed first and last name
Audio: superimposed name spoken twice
Illustrates: Hartman's simultaneous information condition

Program 11
Video: scene from *The Mary Tyler Moore Show* with Lou and Mary
Audio: audio track from the same scene
Illustrates: Pezdek and Stevens' A/V match condition

Program 12
Video: another scene from *The Mary Tyler Moore Show* with Lou and Mary
Audio: audio track from a third scene with Lou and Mary
Illustrates: Pezdek and Stevens' A/V mismatch condition

Program 13
Video: news videotape showing a dead dolphin on a beach
Audio: announcer saying, "The carcasses of dolphins are washing up on the beaches of Spain this summer."
Illustrates: Reese's redundant condition, Drew and Grimes' redundant condition, Grimes' match/specific condition

Program 14
Video: news videotape showing confiscated illegal drugs
Audio: announcer saying, "International delegates discussed the causes of child abuse and neglect at a conference in West Germany."
Illustrates: Reese's nonredundant condition, Drew and Grimes' nonredundant condition, Grimes' mismatch condition

Program 15
Video: news videotape showing a row of cars in good condition in a shopping plaza parking lot
Audio: announcer saying, "Vandals did five hundred dollars' damage to a car parked at the shopping plaza."
Illustrates: Grimes' thematically related, match-general condition

Table 2

Frequency of Audience Responses

		Audio/Video Relationship			
Program	Scale	Redundant	Neutral	Nonredundant	χ^2
1	same/opposite	102	6	1	.45
	match/mismatch	103	4	2	.33
	related/unrelated	104	3	2	.23
	reinforcing/contradictory	101	7	1	.58
2	same/opposite	108	1	0	.01
	match/mismatch	108	0	1	.01
	related/unrelated	107	2	0	.04
	reinforcing/contradictory	106	2	1	.08
3	related/unrelated	5	0	104	.23
4	reinforcing/contradictory	4	10	95	1.80
5	related/unrelated	37	7	65	17.76*
6	related/unrelated	7	2	100	.74
7	same/opposite	92	15	2	2.65
	match/mismatch	99	7	3	.92
	related/unrelated	105	2	2	.15
	reinforcing/contradictory	106	2	1	.08
8	same/opposite	108	1	0	.01
	match/mismatch	109	0	0	0
	related/unrelated	109	0	0	0
	reinforcing/contradictory	109	0	0	0
9	same/opposite	105	4	0	.15
	match/mismatch	108	1	0	.01
	related/unrelated	109	0	0	0
	reinforcing/contradictory	108	1	0	.01
10	same/opposite	96	6	7	1.55
	match/mismatch	96	5	8	1.55
	related/unrelated	99	6	4	.92
	reinforcing/contradictory	95	8	6	1.80
11	match/mismatch	97	6	5	1.32
12	match/mismatch	6	3	100	.74
13	same/opposite	103	5	1	.33
	match/mismatch	105	2	2	.15
	related/unrelated	105	2	2	.15
	reinforcing/contradictory	102	4	3	.45
14	match/mismatch	5	0	104	.23
15	match/mismatch	75	16	18	10.60*

*p < .01

the researchers. Producers' perceptions were extremely highly correlated with audience perceptions ($r=.99$, $p<.001$).

Seven of the stimulus programs embodied redundant combinations--those the researchers described as redundant, matching, related, or equivalent. Audience perceptions of these programs were consistent with the researchers' perceptions. These programs included the combinations that Hartman (1961b) and Severin (1967) distinguished as being completely redundant or merely related, but that Conway (1968) considered "referentially equivalent." A comparison of mean audience responses on the match/mismatch scale for the four programs involved in this dispute showed that the audience did not distinguish differing degrees of relatedness [$F(4,436)=2.03$, $p>.05$], thus supporting Conway's position.

Five programs embodied nonredundant audio/video combinations--those the researchers characterized as unrelated, contradictory, mismatched or nonredundant. Audience perceptions of these programs matched the perceptions of the researchers.

Three programs embodied researchers' attempts to create audio/video combinations that were neither completely redundant nor completely nonredundant. The researchers' names for these combinations reflect their ambiguous nature.

Warshaw's (1978) "incomplete redundancy" combination consisted of a picture of a dog in the video channel with an announcer saying "animal" in the audio channel. The audience did agree that the combination was more redundant than nonredundant. However, this program received the highest number of +2 ratings across all four scales (average frequency = 34.5), indicating the audience perceived the between-channel relationship to be less than completely redundant.

Severin's (1967) "unrelated, same category" combination consisted of a picture of a bison with the spoken word "moose." The audience did not agree that the channels were unrelated. It is likely that, although many of the subjects knew the picture on the screen was not that of a moose, many others did not. Those subjects may have assumed that the unfamiliar shaggy animal was indeed a moose because it was presented together with that audio label.

Grimes' (1989) "related/match-general" combination was represented in this study by video of a row of cars in good condition in a shopping plaza parking lot, while the announcer in the audio channel said, "Vandals did five hundred dollars' damage to a car parked at the shopping plaza." The audience did not agree that the audio and video were related. This program also received the highest number of +1 ratings (average frequency = 32) and the highest number of neutral ratings (average frequency = 20) across all four scales. The audience was very sensitive to the mixture of supporting and conflicting elements in this audio/video combination.

On the whole, the subjects' responses support the researchers' descriptions of the programs, finding redundancy and nonredundancy where the researchers said it would be, and diverging on programs that attempted to mix redundant and nonredundant elements.

Conclusion

In this study, audience members, television producers and redundancy researchers interpreted simple, straightforward combinations of audio and video in fundamentally the same way. This consensus on audio/video relationships could provide the foundation for the development of more precise categories of between-channel redundancy. However, the programs and the instrument used in this study may be too simple to accommodate the complexity of a typical television message with all its variable relationships. Future research to define redundancy categories should employ the rich descriptions of qualitative methods, which more closely parallel the nature of television.

While audience interpretations in this study were quite similar to those of researchers, the more complex and ambiguous the audio/video relationships were, the more varied the interpretations became. Therefore, future studies of the effects of different audio/video combinations should continue to measure rather than assume audience interpretations of the messages. Reports of these studies should describe the television messages used with great precision, consistency and detail.

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Environmental Linguistics: A Typology of Visual Factors in Shopping Malls

by
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Environmental communication research can be difficult to interpret and assimilate because of the tremendous diversity of research approaches and variety of disciplines that are involved. This research takes many forms, and there is often very little similarity in jargon, motives and methods across disciplines. Lewis (1979) refers to a particularly important perspective on understanding environment. Landscape is seen as text to be read (Lewis 1979). This perspective raises an important issue. If we are to read landscapes, then we must be able to understand or define the terms. The grammar of environmental language must be opened up for the enlightenment and enjoyment of all, if environmental design is to rise above the level of superficial discussion of aesthetics. The call is open for understanding of environmental linguistics.

Research from several fields is relevant to explorations of environment as a form of communication. Design research has focused on aesthetic values and form. Psychologists have focused on human responses to the environment, and environmental cognition. Marketing research has focused on identifying factors that contribute to spatial images that increase the likelihood that shoppers will make a purchase (Bitner 1992; Snyder 1989). Another major area of research concerns body language, territoriality and personal space (Malandro, Barker and Barker 1989). This line of research suggests that communication occurs at many levels other than verbal. Social geographers such as Harvey (1985) and Soja (1989) have suggested that space can express the values of the current social order. From these diverse research backgrounds, there emerges a confusion of methods, and jargon that can be difficult to decipher.

Interdisciplinary diversity can offer opportunities for a variety of research approaches, but can also become an obstacle to the exchange of information between disciplines. There are many elements that can be drawn from diverse fields of research to form the basis for a new environmental research discipline. This paper will explore some requisite philosophical underpinnings, and sample possible research within this new discipline, that will be referred to as **environmental linguistics**.

Environmental Linguistics

Environmental linguistics draws from much of the research that we have come to recognize as being relevant to environmental psychology, blended with theories of design, marketing, communications and other social science disciplines. Current environmental behavior research has been difficult to apply in the built environment because it is based in vague terms. Complexity, coherence, legibility and mystery have been identified as constructs that are relevant to human understanding of space (Kaplan & Kaplan, 1982). Line, texture, form harmony, balance, and a host of other principles have been identified as environmental factors that contribute to our enjoyment and understanding of the world around us. The goal of environmental linguistics is to demystify some of these constructs.

Theories that seek to explain the environment have a natural tendency to be holistic. This often leads to problems with construct deffinition. Environmental constructs are often intangible and charged with emotional interpretation. The concept of mystery, as an example, has very personal and specific meanings to various individuals. The objective of environmental linguistics is to create a forum for theoretical exploration of the built environment as a communication tool, that preserves a holistic perspective, but avoids ill-defined constructs.

Built Environment as Language

Metaphor is an excellent way to communicate complex meaning (Stern 1990). The carefully guided images of the poet can take us back in time to environments and cities of old (Blanchard 1985). The simple smell of jasmine in the springtime air can take us back to experiences of our youth. With this concept as a point of embarkment, the following discussion should take you, through metaphor, to an image of environmental linguistics

The built environment is like a language. It communicates the intentions and values of the builder. The similarities do not stop there, however. Verbal communication is filled with uncertainty and change, but it has a formalized system (de Saussure 1959) for maintaining consistency, that allows us to communicate. The written word provides a durable record of thought. We formalize language through the use of dictionaries and grammatical rules. These form standards that help maintain consistency of Language, but change still permeates language. Language evolves over time (Arlotto 1972; Lyons 1981). Over use of emotion-charged words results in diminished values and meaning. The word "super" is now so common that we use it to refer to anything from grocery stores to weekly discount carpet sales. The word "awesome" is becoming trite. As language evolves and meanings change, we loose touch with past significance.

This process is similar to the evolution of the built environment. The social significance of space changes with new experiences and relationships within the relevant spatial environment. Although the existence of the built environment provides a durable record of ideas and values that led to its creation, there are no dictionaries or grammatical texts to preserve spatial meaning across generations. As a result, the changes in environmental meaning occur at a much faster rate.

An example of rapidly changing spatial language can be seen in eastern Europe. The spatial symbolism of the communist party has been quickly dismantled. The icons of a displaced government are quickly replaced by those of the new ruling order. New meanings and new environmental symbols will need to be generated for the new social order that is being generated in eastern European governments. It is likely that many outward expressions of the old social order will remain, but the significance may change or be lost.

The concept of styles and fads demonstrate the rapid change of environmental language. Trends and fads are constantly found in the design of space. This does not preclude the existence of more consistent environmental language, but the picture of environment that is constant and unchanging is simply not viable. Treating the built environment as a language requires a recognition of its dynamic nature.

What do Various Disciplines Have to Offer?

It is clear that meanings are conveyed to individuals from environmental experience (Kaplan and Kaplan 1982; Rapoport 1982; Meinig 1979a) and that these meanings influence the behavior of consumers (Bitner 1992). Sommer (1969) warns of problems created by environmental designers that fail to consider social ramifications of spatial design. It is evident that environmental and spatial needs (Sommer 1969; Kaplan and Kaplan 1982; Rapoport 1982) and opportunities to influence behavior through design modification exist (Whyte 1980; Kaufmann 1990). Unfortunately, little within these principles is found to address the "How to?" questions relevant to spatial design. An exploration of some difficulties with existing research is in order.

A serious problem in many research efforts is the reliance on constructs that are ill-defined. Several constructs, such as mystery, complexity, legibility and coherence, have been linked to environmental perception (Kaplan and Kaplan 1982). These constructs are useful in explaining individual preference for one space over another, yet it remains difficult and unclear how to incorporate qualities into the design of space that will consistently elicit positive preference responses.

Marketing research has pursued a different approach to this kind of research. Much of marketing draws on the concept of image (Darden & Ashton 1974; Cardozo 1974; Bitner 1992). Image in this case refers to the general conceptualization or schema that an individual possesses relative to a particular store (See Boulding 1956 for a discussion of image). The ability to convey appropriate messages about a store through a sound marketing plan is essential to a store's success. This is likely to be true for the design of exterior commercial space, since business place forms a vital component of a marketing plan. Unfortunately, it can often be more difficult to renovate a failed or outdated place than it is to change marketing concepts. The difficulty with this research is that it is generally focused on the marketing of the business within commercial space as opposed to making market supportive space.

Cognitive psychology has contributed a great deal to the understanding of environmental meaning. Network theory (Best 1989) has extensive application to the design of place. This theory essentially states that memories are encoded in a network-like system. As we are exposed to experiences, or stimuli, a network is activated that will bring other memories to the surface. This helps explain how an odor can remind us of youthful memories. It helps explain how the poets words can evoke stronger images often than real environments and experiences. The human focus of this research can become an obstacle to application of the results to spatial design. Often the objective of the research is found in a desire to understand humanity rather than its interaction with environment.

Sommer (1969), Hall (1969) and Ashcraft (1976) have explored the domain of personal space. This concept is vital to the development of appropriate public space (Mehrabian 1976). Their research demonstrates that environmental issues have real effects on human existence. This does not require acceptance of the deterministic view of environment that once was popular in the field of design. Appropriate spatial designs may be necessary for specific social functions to occur, but appropriate design is not likely to assure optimal behavior.

Spaces that are designed for social interactions are important. The improvement of social experience that is obtained through social contact need to be fostered, but this can only be achieved through consistent understanding of the language of space. Is it enough to say that people need space that facilitates social functions? Is it even enough to create space that is more user friendly. The design of space must speak to us in a more significant way than this.

A problem that has become increasingly apparent is the lack of consistency in terminology across disciplines. The meaning of space to a geographer can be very different than to an economist or an architect. These differences in approaches accentuate the need for careful integration of research between disciplines. Envisioning the environment in terms of language opens up possibilities of how to address these problems through interdisciplinary dialog.

An Exploration of Communication Factors in Shopping Malls

The American Shopping "Landscape" has come to characterize many of our societal values today. The center of power has moved to the mall. Communities such as Brea, California have gone so far as to move city hall to sites adjacent to the mall. Shopping and associated social experiences have become the focus of social interaction outside the home (Kowinski 1978). This shift in community identity and makeup has reduced the importance of old community patterns. In many rural and inner city settings, community commercial patterns have been dramatically altered (Woods 1990). Underdeveloped communities in inner cities and rural areas need to have the access to understanding of environmental language in order to compete against larger commercial areas in regional population centers.

One of the areas that is often a concern in the design of commercial space is that store space should enhance the customer's image of the store pricing policy. Discount store operators want to convey the message that prices are low. For this reason, the issue of price was selected as the focus of an exploratory survey.

A group of 64 students from a visual communications course were divided randomly into two groups. They were asked one of two sets of questions. Both groups were asked to view a series of 23 scenes from shopping centers in the southeastern US. These were presented as slides for 30 seconds, followed by a blank slide that allowed time to answer survey questions. The first three scenes were selected to show a broad range of types and were omitted from the evaluation as practice slides.

The scenes were evaluated by three design professionals to include a range of architectural styles and spatial arrangements. The intent was to have a broad range of spatial characteristics, but to offer some repetition. Slides were then randomized, and presented to both groups at the same time (For a review of the validity of slides as a representation of physical environments, see Shuttleworth 1980).

Group one was asked to evaluate each scene and enter a stapel scale rating (For an evaluation of the stapel scale rating method see Hawkins 1975) of what they would expect pricing policy to be in the stores in the scene. Group two was asked to enter their preference for each scene (For a review of this approach see Kaplan R. 1979 & 1985; Kaplan S. 1979). Both groups were then asked to rate the likelihood that they would choose to shop in a commercial area like the one shown. In addition, participants were asked to list several words describing the stores in the shopping center, and to list names of stores they might expect to find there. The number of descriptive words and expected stores were combined and used as an indication of the describability of a scene. Mean scores were computed for expected price, preference, likelihood to shop and the number of descriptive words that participants were able to list for each scene. A summary of the findings from the statistical analysis is found in Table 1.

A qualitative analysis was performed by placing the scenes in rank order according to preference, price, likelihood to shop and describability. The scenes were then evaluated visually to identify factors that could explain the rating of each scene. An evaluation of descriptive words listed by participants was also used to identify additional factors. These factors are listed in Table 2.

Table 1: Summary of Correlation Analysis Results

Relationship	Correlation Coefficient
Preference is related to likelihood to shop.	*0.9021*
Preference is not strongly related to perceived price.	*0.3846*
Preference is unrelated to describability.	*0.1186*
Price is not strongly related to likelihood to shop.	*-0.3387*
Price is not related to describability.	*0.1320*

Note: Conclusions are based on a correlational analysis of mean ratings for each variable.

Table 2: Factors That May Influence Preference, and Expected Price.

Spatial Articulation: *Three dimensional articulation of building facades may increase preference and expected price.*
Color: *Warm colors and rich colors may increase preference and expected price.*
Planting: *Increased use of plant material may increase preference and expected price.*
Building Materials: *Rich building materials such as brick and stone may increase preference and expected price.*
Positive Store Reputation: *Positive experience with a store or chain may increase preference.*
Regional Mall Similarity: *The perception of large size and regional appeal may increase preference and expected price.*
Age: *Newness may increase preference and expected price.*
Light Standards: *Presence of large, highway style light fixtures may reduce preference and expected price.*

Note: These factors are predicted to contribute to preference and expected price ratings, based on a qualitative analysis of the scenes and comments made by survey participants.

Discussion of Findings

Because of the exploratory nature of this study, it is somewhat difficult to be certain of the confidence of these findings. Problems that could affect the validity of the results include order effects, and the external influence that may have been created through participant recognition of stores from signage. At least some of the reaction may have been due to their familiarity with the individual businesses shown. There was also a clear fatigue factor that seemed to enter into ratings after about scene 15.

In view of these considerations, it does seem clear that in the absence of experience with service and pricing policies of stores in a shopping center, individuals will shop in places that they like. The lack of a strong correlation between expected price and preference would also indicate that attractive shopping areas can be designed that will still be of interest to bargain conscious shoppers.

The qualitative analysis also indicates that environmental variables, such as those listed in Table 2, should be explored to discover what messages are sent by their inclusion in designed space. The issues of spatial articulation and color, for example, seemed to stand out as clear indicators of preference for the scenes. Color and age may also have a relationship to the price message. If these variables are linked to explicit perceptions of store characteristics, it may be possible to design commercial space that conveys the merchant's intended image.

Conclusions

Design research must move toward an approach to understanding space that enables us to be more deliberate in the design of space that is rich in meaning. This will require the reevaluation of space in terms of its communicative properties. Knowledge gained in related disciplines must be integrated to increase the range of research perspectives.

Designers need to be more aware of the implications of their design on social patterns. The built environment speaks to the users of space. This speach can be meaningful or banal, eloquent or crude. It is time that we learn to speak the language of environment, and promote spatial literacy.

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Icon Images in HyperCard: An Exploration of Visual Concepts with Middle School Students

by
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The purpose of this project was to investigate, in an informal and exploratory manner, the reactions of students to unfamiliar or uncommon symbols used as computer screen icons. HyperCard for the Macintosh computer was used to produce a presentation program of general information about a special interest recreational activity. The activity chosen was the building and flying of radio controlled model airplanes. Middle school students were asked to review the program and discuss their opinions about its quality and effectiveness. A record of student activity within the program was available to the interviewer.

Since this project was primarily concerned with the unique qualities of computer hypertext or hypermedia capabilities, it might be appropriate to spend some time reviewing the particular characteristics of HyperCard for those who may not be familiar with it. HyperCard, as its name implies, allows users to view or develop informational presentations or collections of data on computer simulated cards. The card metaphor allows those interested in creating programs easy access to the development process due to its association with the familiar concept of a stack of file cards. After designing a format for a stack of cards, developers may enter text information to be displayed on each card in areas called fields, draw or import graphics, and create *buttons* for moving from card to card. Figure 1 shows a typical symbol or icon used in HyperCard as a button. It is the ability to create buttons which gives this program its unique capabilities and qualifies it as a hypermedia product. Although in many applications the screen cards can be viewed in a linear progression, it is also possible to create presentations in which users can jump through a stack of cards viewing only those cards which are related by a common theme or thread.

Buttons serve many different functions in HyperCard including activating sounds, providing help, or displaying a new card. When a button causes the display of a new card, this is sometimes thought of as navigation. Clicking the mouse pointer on a navigation button sets the user on a particular course through the program. Such courses are usually not irreversible because most hypertext programs allow the user to return to a starting place at any time. Because of this capacity, navigation through such a program can become an exploration in which the user investigates the contents of various

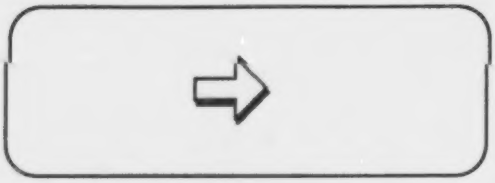


Figure 1. Typical button icon.

cards and can continue on a path of discovery about related information or return to the beginning.

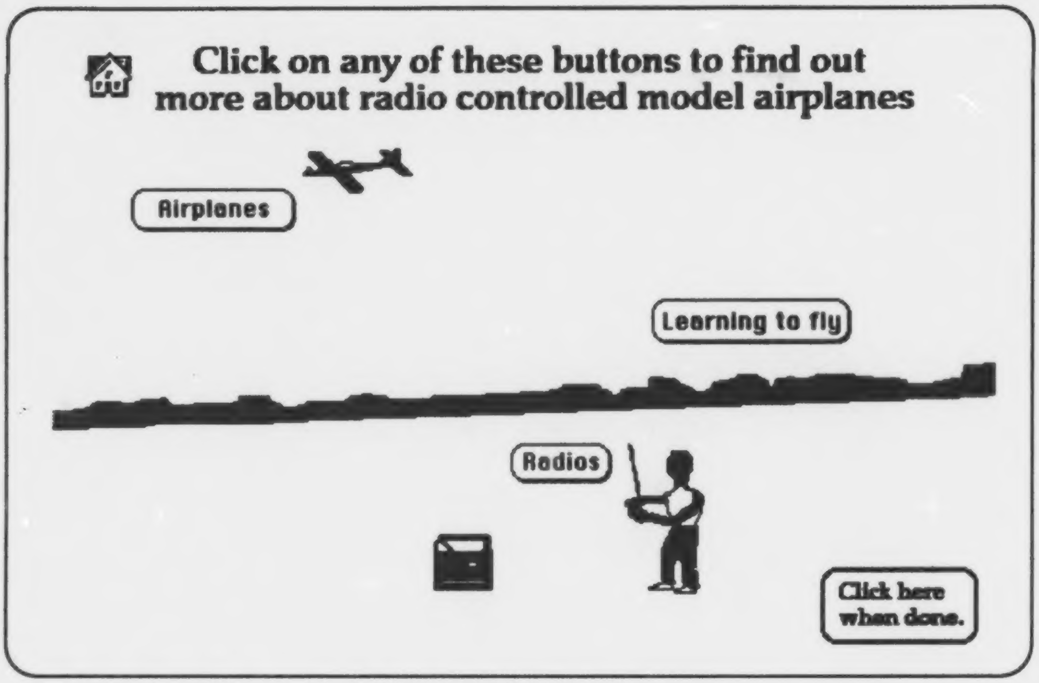
When creating buttons it is possible to keep a record of how often they are pressed. It is this feature of HyperCard that allows anyone interested in testing individual responses to presentations to track a user's choices and determine what areas (via buttons) were explored. For example, buttons representing areas of information about a particular subject might be created for a screen display. If the topic were the Vietnam war and various buttons were displayed indicating that each would provide more information in a specific area such as dates, biographies, or geography user interest in these areas could be measured by comparing the number of times each button was chosen.

The purpose of this particular exploration was to investigate middle school students' responses to buttons which contained small graphic representations instead of text descriptions. Since buttons can be utilized as gateways to information, their design may be important in creating programs which encourage and foster curiosity, interest, and enthusiastic exploration. Several questions were raised about the design and appearance of buttons. Do buttons containing one or two words have a "flat" appearance when contrasted to buttons containing graphic elements? When buttons containing graphic clues to the information they represent are displayed, what is their relationship to viewers' curiosity? How close must the link between graphic and information be? Might program users bypass buttons with unfamiliar graphic representations?

In order to discover a means for answering these questions a Hypercard stack was created covering a topic with which middle school students were unlikely to be familiar. Unfamiliarity was considered important so that students' knowledge of a subject area not interfere with their exploration choices. Consequently, very little of the information in the presentation was of a nature which might cause students to think "I already know about that" and therefore avoid choosing a button because of a perceived familiarity.

Figure 2 shows the screen display that is central to the navigation of the presentation. There are three possible courses to take from this screen as represented by the three buttons, "Airplanes", "Radios", and "Learning to fly". In addition there is a button to click when finished. After viewing text, animation, or pictures relating to one of the three topics, students are returned to this screen.

Each of the three topic sections contain other buttons which provide additional information, begin an animation, or return the user to the beginning. There are twenty-two buttons in the entire presentation and a special card which can display how many times each button has been pressed. Access to this card was limited to the study supervisor.

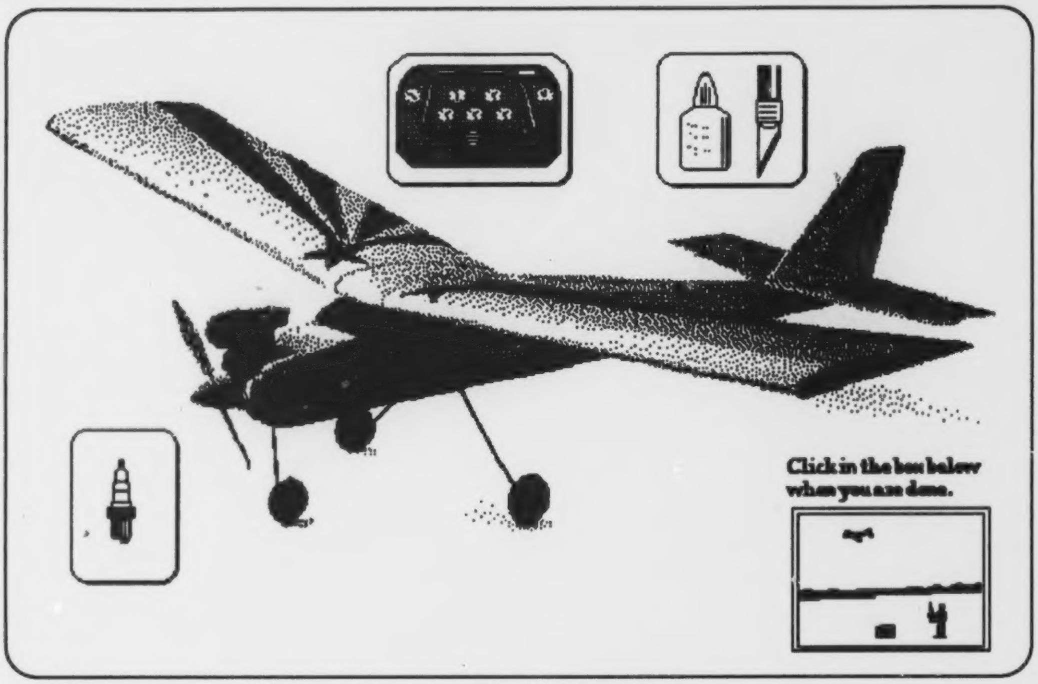


Click on any of these buttons to find out more about radio controlled model airplanes

Figure 2. The main screen.

The presentation was viewed by three groups. First, a brief formative evaluation was done using a group of six seventh and eighth grade boys and girls. The program was installed on a computer in the school media center. A glass partition separates a small work area from the rest of the room and the computer was set up in that work area. Students were chosen from an adjacent study hall and given basic information about the project which emphasized that it was the program itself which was being tested and that students should only do what interested them. In addition to time spent at the computer and the number of times each button was pressed being recorded, students were interviewed briefly about the general appeal and comprehensibility of the presentation. As a result of this procedure, it was determined that students generally enjoyed viewing the program, were not confused about how to navigate via the buttons and, as evidenced by the record of button presses, seemed willing to explore most areas of information.

In the second and third groups, students were shown the presentation under the same conditions described above but the presentation was altered. One of the cards (figure 3) was redesigned so that three buttons, which provide additional information about three topics related to a model plane, contained small drawings intended to relate to the ideas and information to be presented. In the second group, students were given as much time as they wished to explore the program. After completion they were shown a paper copy of the screen containing the picture buttons and asked to relate what they first thought when presented with this screen. They were then asked what they thought each button represented and what



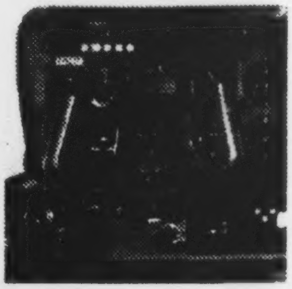
Click in the box below when you are done.

Figure 3. The Airplane card.

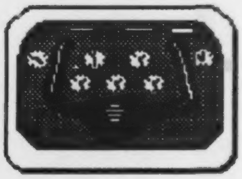
they thought might happen if they chose it. Since their answers were naturally affected by the fact that most of them had already seen what the result of choosing each button was, it was decided to interrupt students at the point at which they first encountered the atypical screen and ask them what they thought each of the three button pictures represented and to predict what they thought might happen if they were to click on each one of the graphic buttons.

The results of this activity were examined in two ways. First, the number of button presses was tallied. Results showed several interesting trends. For example, approximately half of the students did not explore information about the various parts of a model engine. On the other hand, a button which activated an animated demonstration of the control levers of a radio was clicked an average of two times and all students chose to click it at least once. Since this project was an exploratory study and not rigorous research, no formal conclusions could be drawn from this data except that this means of recording students' reactions to screen presentations might be a viable way of conducting meaningful studies.

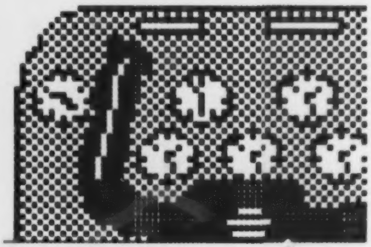
Interviews with students provided insights into questions concerning the effectiveness, appeal, and clarity of the graphic buttons. When asked what they thought the buttons meant, a majority of the students recognized the hobby knife, the glue bottle, and the cockpit and were able to accurately predict what might happen when each button was clicked. Not surprisingly, the spark plug was less able to elicit an accurate response. Most students did not know what it was and therefore had no idea



Scanned image of photograph.



Button: actual screen size.



Enlargement of button icon.

Figure 4

what it might lead to. An interesting question here is whether or not that arose from lack of familiarity with spark plugs or from the poor quality of the representation. Figure 4 shows the transformation of the cockpit to a screen button. In the enlarged view it is easy to see how the low resolution of the screen affects the ability of this particular application to create accurate artwork. The surprise here is that students were able to relate at all to these crude, jagged-edged icons. An airplane cockpit can hardly be thought of as a common object. One would guess that only a minority of 12 and 13 year old students have ever actually been in a cockpit. Is it the preponderance of video and the exposure of children to a wealth of visual data that makes them so visually erudite? None of the students questioned mentioned the key word—yoke—that distinguishes this picture from the control panel of a tractor or dozens of other types of modern equipment. They may not have known its name but they knew what it was. It was also discovered that the students who did not recognize what the button graphics represented tended not to choose them. Work may need to be done in this area to accurately determine the effect of pictorial buttons as used in hypermedia.

The use of hypermedia software to develop a short line of inquiry turned out to be entirely successful. Development of the presentation was relatively simple and a wide variety of questions could be explored. With an increasing reliance on mouse pointing in educational software it would appear that there are many questions relating to screen design that need to be answered and the use of a product such as HyperCard may be an excellent method for approaching such questions.

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Pilot Testing Instructional Software with Video: Cross Cultural Implications

by

William J. Gibbs and Vichuda Rattanapian

Introduction

The challenges of ever expanding class sizes and associated class loads have forced many universities to investigate computer technology for education. In today's classroom it is commonplace to see computer and/or integrated multimedia workstation applications employed for instructional purposes in both presentational and self-instructional modes. More-over, there appears to be an interest on part of many instructors to be involved in developing such products. Few faculty, however, have the time to construct these systems. Given this problem, a remedy lies in authoring systems (Garrett, Noblitt, & Dominguez, 1989). The functionality and accessibility of many computer authoring systems has enabled some educators to assume the role of instructional software developer. Instructors can prepare class presentations which incorporate graphics, sound, animation and video. Similar self-instructional programs can be developed for students' independent use. As Suzuki (1987) notes, the novice author can develop Computer Assisted Instruction (CAI) in a relatively short period of time.

The ability to create fairly sophisticated software lessons using an authoring system has inspired individuals from an array of disciplines to develop their own instructional courseware. Unfortunately, what is sometimes missing from these lessons is the application of sound instructional design methodologies. Lessons, for example, are developed and implemented without some type of formative evaluation. In formative evaluation the program's worth can be determined and decisions about program revisions are made during its development (Gagne', Briggs, & Wager, 1992). These procedures enable one to "gain the capacity to confirm decisions pertaining to the program as valid, to improve efforts if required, or to modify thinking when necessary" (Hannafin & Peck, 1988, p. 299). In order to assist instructors with their software development efforts the Behavioral Learning Center at Penn State's Smeal College of Business Administration implemented a method to pilot test instructional software. According to Allessi and Trollip (1985, p. 384), "pilot testing is a process whereby representatives from a target audience use and test lessons while their progress and performance are monitored." The purpose of this article is to suggest some advantages to using video technology in pilot testing a CAI prototype. It examines the impact of visualizing subjects' operations in a lesson and the implications this has for improving instructional software, as well as pilot testing procedures. Moreover, the article discusses the impact of using video to assess the influence culture has on subjects' reactions to a CAI prototype and the pilot testing experience.

Background

The systematic design of instructional software increases its likelihood of successful implementation. All too often, however, trained instructional designers are not included on teams responsible for designing and developing programs (Gayeski, 1989). What can result is poorly designed instruction. What often appears intuitive to the untrained developer can mystify the student. Further, programs that work flawlessly in a controlled setting can "crash" in the field. For these reasons, testing prior to courseware implementation is critical to its success. Courseware developed without being put through formative evaluation processes will likely create difficulty for students using it (Suzuki, 1987). This testing or evaluation is possibly the most frequently disregarded component of the systems model (Hannafin & Peck, 1988).

To ensure the adequacy of instructional software developed by instructors, the Behavioral Learning Center set up procedures for pilot testing programs. Three factors were considered when establishing an evaluation technique. First, the information collected needed to be multi-channeled and not limited to students' verbal responses to questions. Although verbal responses are worthwhile, there are other response types which can provide valuable information. Many channels of communication serve to exchange messages and are important such as facial expressions, eye contact, and body gestures (Wrightsman & Deaux, 1981). This is particularly important when observing international subjects. Language barriers can impede an observer's ability to interpret verbal responses. Therefore, nonverbal communication can aid the observer in understanding responses. "Nonverbal communication includes the space or distance between communications, touching, body messages, and voice characteristics" (Pederson, Wright, & Weitz, 1981, p. 247).

Second, because individuals of a particular culture will not perceive something totally alien to their cultural experience, or they will interpret it by some referent to their own cultural (Mangan, 1978), the target audience needed to be culturally diversified. This was important because many international students studying at Penn State are users of instructional software. Thus, the testing method had to be capable of documenting any effects on students' reaction patterns which were culturally based.

Third, the accounts of several observers monitoring the same event often vary due to personal biases (Van Dalen, 1979). For this reason, an instrument unaffected by personal bias was required.

The adopted approach included video recording all pilot testing sessions. Subjects' verbal, nonverbal and attitudinal reactions to the courseware were recorded, as well as their paths through the lesson. This technique provided the testing moderator with a permanent visual record of evaluation. The visual medium allowed the recording of multi-channeled communications and subsequent analysis of it by replaying the video tape.

Description of Population

The sample population used in pilot testing consisted of 5 U.S. students and 5 Thai students. The U.S. students were undergraduate and graduate part-time workers at the Smeal College of Business Administration at Penn State. The Thai students were all working on graduate degrees at Penn State and had been in the United States for at least one year but no longer than three years. All subjects were computer novices.

Procedure

Individually, subjects were given a brief introduction to the evaluation session and the program. They were told to think aloud as they used the courseware, to comment on program stimuli as it was presented and to ask questions when necessary. Subjects were left alone to run the program. The moderator monitored subjects' actions and took notes. If significant problems with any program aspect arose, then the counter time on the video tape recorder was marked so that point in the video could be accessed later for review. Subjects could terminate the program at any time. After each session, video tapes were reviewed.

General Observations

Six observations were made pertaining to this form of pilot testing. First, video recording provided a permanent visual and auditory record of the student-computer interaction. The video could be reviewed numerous times to identify subtle details about subjects, the software or the testing situation. Consequently, reviewers could identify problematic program areas more readily. For example, students' comments could be heard and their physical reactions seen along with what was presented on the computer screen. Such observations would be difficult to make with more traditional techniques.

Second, the ability to visualize subjects' reactions concurrently with program stimuli added a clearer understanding of what they liked, understood, disliked and/or found confusing about the courseware. As Allessi and Trollip (1985) point out, the amount of information relevant to students' understanding or confusion about a topic that can be obtained from observation is startling. It is the opinion of the researchers that in this particular case more detailed observations were possible because of the video taping.

Third, observer interruptions were fewer because the video provide a record of testing. The actions of subjects using a CAI lesson are often made rapidly. As a result, the observer may ask the individual to explain the action or to slow down. These interruptions can interfere with pilot testing. This was not the case in the present inquiry. Subjects could move through the courseware as they would under normal conditions. Moderators, for example, found it necessary to interrupt subjects only when they had completed a program segment without exploring all its options.

Fourth, since this method appeared to increase the amount of accessible data, more time was spent in analysis.

Fifth, video recording pilot testing sessions provided useful insights for improving pilot testing techniques. During testing, a moderator observed subjects from a separate room, and periodically asked them questions through an intercom system. This arrangement worked well for the U.S. subjects, but it proved problematic for the internationals. In the moderator's opinion some Thai subjects appeared uneasy with the testing situation. Consequently, the moderator moved into the testing room with these individuals. Possibly because of language differences the moderator prompted the Thai subjects more than the U.S subjects. Prompting was ineffective because it did not give the subject an opportunity to explore the program and its options independently of the moderator. In some cases it was difficult to determine if the subject's choice of a particular option was their own or the result of the moderator's prompting.

Sixth, video taping pilot testing sessions can be considerably more expensive to implement than simply observing students and writing down notes. It requires fairly sophisticated video equipment. The financial obligation of purchasing and maintaining such equipment for pilot testing can be prohibitive (Van Dalen, 1979).

Cultural Observations

People from varying cultural backgrounds will have both obvious and subtle differences which are not associated with ability (Woolfolk, 1990). Video recording evaluation sessions enabled reviewers to visualize how students from different cultures interacted with the courseware, the testing moderators and the testing approach. Consequently, the software and the evaluation approach could be modified to be more culturally sensitive.

A separate video tape was used to record each subject. All tapes were reviewed by three American evaluators and one Thai evaluator. The evaluators were told to write down any observable differences between the U.S. and Thai subjects pertaining to the following areas:

- Number of questions asked

- Type of questions asked
- Interaction with the moderator
- Interaction with the program
- Comfort with the testing environment
- Comfort with computer

The following list is a summary of observations made by the evaluators.

Thai subjects tended to:

1. Ask fewer questions than U.S. subjects. This data is shown in Table 1.

Table 1. Number of questions subjects asked during testing.

Number of Questions Asked		
U.S. Subjects		Thai Subjects
1.	27	15
2.	44	5
3.	26	15
4.	17	4
5.	15	9
Total	129	48

2. Hesitate before exploring program options more so than U.S. subjects. It appeared that the Thai subjects waited for a prompt from the moderator before moving on in the lesson. While this observation may be indicative of a cultural influence, the moderator's presence with some Thai subjects during testing may have affected their use of the program. This same effect may be present with the U.S. subjects given the presence of a moderator.

3. Present a more inhibited demeanor than the U.S. subjects. Cultural differences will result in communication differences. As Woolfolk (1990, p.122) indicates, for example, "some groups listen while giving strong affirmative nods and other nonverbal cues, while others listen without acknowledgement."

4. Comment less and make fewer suggestions than U.S. subjects. Thai subjects tended to wait for a question by the moderator before commenting on a program feature.

5. Follow the moderator's instructions verbatim. Their exploration of the courseware was limited to the moderator's directive. This observation may not be indicative of a cultural influence but an effect caused by the presence of the moderator. It should be noted, however, that even the Thai subjects who used the program without the moderator being present appeared to wait for a directive before proceeding.

6. Approach evaluation more seriously and more formally. Thai subjects tended to sit up straight in their chairs. Their body language appeared to suggest that they took this exercise seriousl.

7. Wait for assistance from the moderator when problems arose.

8. Maintain a great deal of patience when problems arose.

9. Question the utility and functionality of program features less often than the U.S. subjects.

10. Spend less time in testing than U.S. Subjects. This data is shown in Table 2.

Table 2. Amount of time each subject spent in testing.

Time in Testing (minutes)		
U.S. Subjects		Thai Subjects
1.	49.24	36.27
2.	48.43	24.30
3.	54.33	34.26
4.	32.45	17.47
5.	26.55	24.31
Average:	42.20	27.30

U.S. subjects tended to:

1. Ask numerous questions about the program and its features. Refer to Table 1.

2. Approach the evaluation task more assertively than Thai subjects. For example, when U.S. subjects encountered an option or program feature unfamiliar to them or one which they disliked, they generally commented immediately. U.S. subjects also appeared to express their reactions more directly and freely. For instance, they stated comments similar to the following: "I do not like the color of this table" or "The text in this screen is too small." or "This button doesn't work right".

3. Approach the courseware less conservatively than Thai subjects. During pilot testing U.S. subjects appeared to explore program options sooner than Thai subjects. Generally, they approached the software by clicking the mouse around the screen trying out various screen, buttons.

4. Present a more relaxed demeanor during pilot testing. While testing the prototype, the U.S. subjects leaned backwards in the chair, touched the computer screen and generally talked louder than Thai subjects.

There appeared to be no observable differences between the types of question asked by the Thai and U.S. subjects. The majority of questions focused on program interface issues. For example, subjects wanted explanations as to the meaning of various icons. They questioned the placement of symbols, tables, and textual information. Some subjects were more detailed than others in their observations, indicating very specific aspects of the courseware which needed improvement. However, such questions and observations occurred across both groups and seem to be based more on individual preferences than cultural differences.

The moderator's presence with some of the Thai subjects appeared to confound testing. It was observed that Thai subjects relied on and deferred to the moderator more so than the U.S. subjects. It is difficult to determine if this behavior resulted from cultural influences, language barriers or the moderator's presence. This is an important issue requiring further investigation. If international students are to use courseware, their input is vital in the CAI development stage. From the present study, there appear to be differences between international and U.S. subjects' pilot testing behavior which must be considered in order to collect useful data. The moderators in the current study sat with some of the internationals during testing to create a more comfortable environment and to help alleviate language difficulties. In attempting to accommodate these subjects the moderator may have curtailed subjects' desire to explore the courseware. Furthermore, after reviewing the video tapes several times it was clearly evident that some reactions reflected the personal biases of the moderator. From the moderator's perspective the Thai students directed their own paths through the courseware. They selected options independently. After reviewing the video tapes, however, it appeared that the moderator's questions directed the subjects. For example, the moderator would ask "what do you think of this option?" and based on that question a lesson path was taken. Without such a question the student may not have tested the option or would have chosen a different lesson path. This information is relevant for developers in understanding which stimuli are effective navigational cues. In retrospect, the moderator's support of the Thai students should have been restricted considerably. The researchers contend that this observation was possible as a result of visualizing pilot testing behavior via video tapes.

The most striking observation was that both groups differentiated themselves by the manner in which they reacted to the courseware. One needs to be cautioned that U.S. students and internationals may perceive a particular program feature in much the same way but display entirely different nonverbal and verbal responses.

Summary

Formative evaluation procedures are necessary for the effective implementation of any CAI program. This paper has suggested a method of pilot testing CAI prototypes using video technology. Video gives the researcher an unbiased instrument with which to visualize the student-computer interface. "Video recordings preserve details in a reproducible form, so that the full accounts of an incident may be studied repeatedly and intensively by the investigator and also may be checked by other research workers" (Van Dalen, 1979, p.165). While using video to observe subjects is not a new concept, its application in this study is unique. Subjects' reactions were recorded concurrently with what was presented on the computer screen.

Given that rapid assimilation of computer technology into the classroom and the accessibility of easy-to-use authoring systems, many educators are anxious to incorporate their software into class materials. This pilot testing technique enables educators to collect a variety of responses (verbal, physical, attitudinal) from subjects which can be used to gain greater insights into students' reactions towards courseware. The impact of being able to visualize subjects' reactions to software cannot be over-emphasized. It clearly added another dimension to evaluating the CAI prototype.

Since perception is influenced by culture (Mangan, 1978), a further consideration in testing software is how students from different cultures react to it. In the present study, U.S. subjects appeared more elaborate in their reactions and generally more assertive during testing than Thai subjects. While both groups were reactive, the manner in which they reacted differed. These observations are preliminary but seem to suggest that internationals interact and react differently during pilot testing than do U.S. subjects. Additional research is needed to investigate the numerous factors which can account for this. Nevertheless, it is apparent that the capability to visualize pilot testing sessions made cultural differences much more observable.

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Visual Acuity of Radiologists: The Important but Forgotten Component of the Radiological Process

by
Barbara C. Good

If there were a metaphor profession for visual literacy, it would most certainly be radiology. Not only is vision of the utmost importance in this medical specialty, but the exercise of diagnostic abilities when one attempts to decipher any type of radiographic image bespeaks "literacy" in a very special language: radiological interpretation. Indeed, when a radiologist talks about his day-to-day activity, he speaks about *reading* an image, he talks about going to the *reading* room, he asks how many films he has to *read* that day.

From the time that Wilhelm Roentgen discovered the x-ray in 1895, numerous articles have been written about many of the different perceptual and interpretive problems that are involved in the diagnosis of radiological images. Image quality has been examined in terms of contrast, brightness, resolution, magnification and minification, edge enhancement, and reversal (i.e., positive vs negative), to name a few concerns (see, e.g., 1-5). Readers themselves have been looked at in terms of their rates of diagnostic accuracy and the contributions they make to the effective treatment of patients within the medical system (6,7). Studies on the observer have focused on such variables as the visual search, search/viewing time, viewing distance, years of experience, and even the effects of alcohol (8-12). Issues of ergonomics in radiology, that is, the different technologies and their configurations that may contribute to an improvement in the relationship between the radiologist and his working environment and thus make the interpretive process easier, more comfortable, and potentially more accurate, have also been studied in recent years (see, e.g., 13). Such environmental factors as increased or decreased room lighting levels, quiet vs noise, chair type, room temperature, and so forth, have been examined by both academic researchers and commercial entities in efforts to arrive at the "ideal" reading environment. In short, the radiologist has been looked at from almost every angle in the attempt to understand the different components of the reading process.

Strangely, the one aspect of the radiological interpretive process that has been generally overlooked is visual acuity itself. Attempting to decipher the reasons for this would only be speculating. Suffice it to say that a

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search of the medical literature the author performed showed that in the past five years only *one* scientific article has addressed the issue of visual acuity in radiologists (14). Because this issue may be of central importance in the practice of radiology, the study described here was carried out. This paper addresses several of the issues raised and data discussed in a commentary the author and two of her co-workers published in 1991 in the *American Journal of Roentgenology* (15).

METHODS

Two data-gathering tools were used in this study: 1) an optometrist-administered eye examination and 2) a short printed survey that asked questions about radiologists' personal visual acuity habits and opinions about the perceived importance of the topic under investigation.

Visual acuity testing. Twenty-eight radiologists (six women, 22 men; ages 30-70) in the Department of Diagnostic Radiology at the University of Pittsburgh Medical Center agreed to have their visual acuity tested by an in-house optometrist. All visual examinations were completed over a period of one week. Distant and near vision were measured (corrected and/or uncorrected without refraction for both eyes) using the standard Snellen and Jaeger eye chart.

Radiology survey. One week later, the 70 faculty radiologists in the Department of Diagnostic Radiology, including those who underwent the acuity examination, were requested to provide answers to a short printed questionnaire. Items examined included: 1) date of the responding individual's immediately previous examination of vision (excluding the experiment reported here); 2) wearing of corrective lenses for various activities; 3) opinions about whether periodic vision examinations should be required for radiologists; and 4) perceived level of importance of the issue of visual acuity to radiologists.

RESULTS

Because it is near vision that radiologists employ when they read an image, only those results from the near visual examination are reported here (Table 1). Examination of the 28 radiologists who participated in this part of the study revealed that 23 of them (82%) had the equivalent of 20/20 vision with or without corrective lenses. Five of the 28 (18%) had less than 20/20 acuity (equivalent to 20/25), three of these with corrective lenses and two without correction. Twenty-three of the 28 wore corrective lenses on a regular basis.

Forty-three radiologists responded to our printed questionnaire. Findings revealed that 29 (67%) of these radiologists had had their vision examined within the past *two* years. Eight (19%) had *not* had their vision checked within the past *three* years, and four (9%) had not had their vision examined within the past *five* years. Thirty-six of the 43 (84%) wore corrective lenses "sometimes" or "always" for film reading. More than half, 26 of the 43, wore corrective lenses "always" for reading film or books.

TABLE 1
Results of near-vision visual acuity testing (N = 28)

Radiologists in whom vision was	Near vision = to 20/20	Near vision = to 20/25
Corrected only	19	3
Uncorrected only	2	2
Corrected and uncorrected	2	-
Totals	23	5

The results of our questionnaire also indicated that 24 of the 43 (56%) radiologists believed that periodic testing of visual acuity should be required in the profession; 16 (37%) thought it should be optional. Only three (7%) felt it should not be required.

Forty-one of the 43 radiologists who responded to the survey believed that the issue of periodic visual acuity testing for radiologists was "very" (19/43) or "somewhat" (22/43) important.

DISCUSSION

From the results of the visual examination, only a minority of those tested (5/27) were recommended for minimal visual correction. However, it should be noted that self selection may have biased these generally good results, since the study was carried out on a voluntary basis and less than one-half of our faculty actually participated. It is likely that those who felt less confident about the excellence of their own visual acuity were those who elected to avoid the examination, and had the examination been a required one, it is possible that more serious visual defects or deterioration would have been discovered.

Should periodic visual acuity tests be required for radiologists--perhaps as a condition for licensure, staff privileges, or malpractice insurance coverage? The idea makes sense to the author. Similar practices are mandatory for other non-medical occupations which rely on visual activity.

The deterioration of vision with age is a phenomenon that is widely acknowledged by both medical professionals and the general public. It is typically a slow and subtle process and could thus potentially go undetected for significant periods. Because of the central role that vision plays in the conduct of the day-to-day activities of radiology, it, of all professions, should be aware of the dangers that may lie in overlooking or undervaluing visual acuity as a component of the interpretive, or "reading," process. Of all the components of the radiological reading process, visual acuity is perhaps the most easily measured and corrected. The expense of regular vision examinations could be well worth the investment when weighed against the possible costs of allowing readers with possibly slowly deteriorating and uncorrected vision to continue to interpret radiological images. The training radiologists receive in how to think visually, how to construct three-dimensional images in the mind, how to arrive at a Gestalt of an image, and how to understand the visible signs of normalcy and disease that present in a radiograph all diminish in value if the eyes through which an image is seen are physiologically faulty.

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Interdisciplinary, Anchored Instruction Using Videotape

by
Robert Myers

The presence of the VCR in the classroom is now a fact of life. Strohmer (1989) reports that the use of video is coming of age. Learning outcomes are also changing, says Strohmer. Teachers are not looking at simple stimulus-response types of learning. She says they are seeing themselves more as facilitators who equip students to think throughout life. Strohmer says that "instead of focusing on facts that must be gotten across, designers are grappling with modeling processes and encouraging thinking" (p. 27).

This study explores the results of a seventh grade teaching team's two-week exercise based on the videotape series *Voyage of the Mimi*. The videotapes provide for the thematic integration of full motion video, print materials, and computer programs. The series consists of 26, 15-minute segments about a scientific expedition to study Humpback Whales off of the Coast of Maine. The crew is headed by a female biologist who is awarded a grant to study whales. Among the racially, ethnically, and gender-mixed crew, are a crusty sea captain, his 11-year old grandson, an oceanographer, a hearing impaired research assistant, and two teenagers.

Literature about this highly popular and visible series is limited--especially research reports concerning its effectiveness. The available information, while anecdotal in nature, is generally favorable. Mastrolia (1991) states that "...there is enough variety and interest so that any student would become actively involved with learning..." (p. 31). An article in *High Technology* ("Grade Schoolers", 1985) cites a math teacher in Cambridge, MA who states: "The program is stimulating and practically limitless in its usefulness" (p. 58). The latter article also suggests that the Mimi series causes female students "to view math and science as both fascinating and accessible" (p. 59).

By Michaela Myers, 7th Grade

Martin (1988) states that the Mimi materials "could create windows of opportunity in which disruption in instructional routines occurred and could be utilized to open a lesson up in positive ways" (p. 6). Not all reviews, however, have been favorable.

Critique of the Mimi

In reviewing the *Voyage of the Mimi*, Postman (1985) states that "media merchants" have created a mindless series, "as if media themselves have no epistemological or political agenda" (p. 154). He undermines a selling point often found in multimedia literature by discounting suggestions that dramatic settings facilitate learning. In addition, he questions why children should be studying Humpback Whales, navigation, and map-reading skills. He opines that the subject matter is highly inappropriate. In short, he suggests that children will only have learned that learning is a form of entertainment. While Mimi advocates will no doubt suffer chagrin at Postman's remarks, he has done the community a favor. His concerns, like those of Clark (1983), cause us to look closely at important and fundamental issues concerning the use of instructional technology.

By Erin Knocke, 7th Grade

Background

Videotape Usage

In a review of electronic learning research, Johnston (1987), suggests that television supports instruction when teachers provide an interface between the program and learners. According to Johnston, factors contributing to success include support materials and an adult who can extend the lesson. He shows one study that resulted in a significant change in females' attitudes about stereotypical gender roles. Even though Johnston cites meta-analyses which show little effect size from the use of instructional television, he states that visual-based instruction has at least "...enabled the classroom to be extended beyond the institutional walls" (p. 51). He cites modeling as a contextual factor influencing a viewer's attention and comprehension.

Modeling

Strohmer (1989) says that models within the format of instructional television play an important role in whether or not learners will process information instead of just passively watching. Human models, she says, are generally more effective--especially a model with whom young viewers can identify or admire. This comment is appropriate to the Mimi series because the developers purposely wanted to show attractive and interesting people engaged in interesting real-world work.

The real-world aspect is important. This paper suggests that one of the defining values of the Mimi series lies in the use of "situated cognition" or "anchored instruction." Both are methods designed to provide life-like environments that show students the importance, application, and relevance of the subject domain.

Anchored Instruction

Gardner (1991) and Bigge (1976) remind their readers that before formal schooling, children learn everyday tasks at a prodigious rate--seemingly with ease and enjoyment. After entering formal educational environments, however, many of the same children find learning difficult--if not downright boring and painful. Bigge points out that students often fail to find or understand the relevance of school subjects to everyday life. The Cognition and Technology Group at Vanderbilt (CTGV, 1990) states that instead of relevance, schools promote the learning of inert knowledge. Inert knowledge is defined as knowledge learned, but often forgotten in appropriate situations.

How could learning in an appropriate context affect the learning process? Brown, Collins, and Duguid (1989) contend that students need more than abstract concepts and canned examples. They suggest that learning should be conducted in activity situated in real-life social, cultural, and physical contexts. It might be impractical, however, to take every middle schooler on a converted tuna trawler to study the habits of Humpback Whales. To get around this problem, Brown, Collins, and Duguid suggest a concept termed "legitimate peripheral participation" (p. 40). This concept applies to persons not taking direct part in an activity, yet still learning a great deal from their peripheral position. With little imagination, this concept could be likened to middle school students viewing the videotape of the Mimi's voyage, then engaging in activities similar to--or congruent with those depicted in the series. Research conducted by the Cognition and Technology Group at Vanderbilt (CTGV, 1990) is a good example of the use of media (videodisc) to "situate" or "anchor" the students within a learning environment.

CTGV submits that new information learned during meaningful activity is perceived as a tool rather than as inert information. They attempt to attack the inert information problem with video environments supportive of sustained exploration. According to them, this sustained exploration allows multiple perspectives and permits opportunities for teacher guided discovery. Their problem solving macrocontexts help students develop tools that form new, as well as modify old perceptions. This is in contrast to traditional instruction that emphasizes mere facts to be memorized. It is suggested that the dramatic series in the *Voyage of the Mimi* videotapes also creates an environment for sustained exploration through relevant tool building activities.

Purpose and Rationale

This study looked at a variety of issues. First, could a seventh grade team currently teaching separate subjects using behavioral or traditional methods effectively use an anchored series in an interdisciplinary mode? Second, could the *Voyage of the Mimi* series be effectively integrated into the school district's standards of learning? Third, were the students learning or only being entertained? Last, in a more quantitative vein, it was hypothesized that female students would come to view math and science more favorably.

Methods

An extant seventh grade class of one hundred and twenty-five students served as participants during the two-week exercise. This particular class was divided into three ability levels (Level 1 denoted those of the highest ability). Each morning the students reported to their home rooms. They viewed one or two of the 13, 15-minute, Mimi episodes. There were little or no previewing discussions, organizers, or questions for the students to consider. After viewing, the students immediately left for their regular classes. Traditionally, the students' day would take them through the four primary classrooms in which they studied English, social studies and geography, math, and science. During the exercise, however, each of the four primary teachers used the Mimi series as the anchor or theme under which lessons were conducted.

A variety of methods was used to assess the exercise. The students completed pre and post exercise surveys. There were five short-answer and 20 Likert scale questions designed to measure the students' attitudes about math and science. Interviews, observation, and assessment of student projects supplemented the surveys.

Table 1

Is math a subject you like or dislike?

Levels:	1	1	2	2	3	3
Gender:	Female	Male	Female	Male	Female	Male
Pre test						
Like	24	19	20	20	6	4
Dislike	2	1	2	2	3	0
Post test						
Like	28	19	21	25	7	5
Dislike	1	1	1	0	0	0

Is science a subject you like or dislike?

Levels:	1	1	2	2	3	3
Gender:	Female	Male	Female	Male	Female	Male
Pre test						
Like	17	17	13	13	3	1
Dislike	6	4	6	10	7	4
Post test						
Like	18	17	11	17	3	3
Dislike	6	4	10	8	4	1

Results

The post exercise questionnaire was administered two weeks after the series. Of the 20 questions using a Likert scale, none showed significant changes in attitude. It may be of interest to note, however, that we had assumed there would be significant gender-related differences concerning math and science reflected on the *pre-exercise* survey. This was not the case. Table 1 shows the results of two of the short answer questions. While there was no significance, there were some subtle changes, especially in the Level 3 students. The reader can note little difference in scores based on gender. One might also surmise that the math (or perhaps the math teacher) class was well liked--both before and after the exercise.

While quantitative results were not significant, the other indicators were positive. Postman was right, the students had fun, but so did the teachers. One teacher remarked that disciplinary problems were down and that students were so involved in the exercise, they were bringing items from home to support the theme. One female student became a local celebrity when she reported on visiting a huge marine museum in California. Others were bringing periodicals such as the *National Geographic*. Their intent was to share and show off articles concerning whales, fishing, and of course--the Titanic. Place mats from Nantucket were soon gracing the walls along with the Mimi posters. Another teacher remarked that the Mimi materials provided a wonderful opportunity to go into so many different areas. In short, exposure to the series provided detailed orientations to topics students could study in greater depth off-line. Instead of being the experts, teachers became facilitators, coordinators, and mentors in guiding the students to critically analyze content.

Can this series be effectively integrated into a curriculum driven by behavioral objectives and standards of learning? During a post-exercise interview, each team member discussed plans for expansion of and further experimentation with his or her methodology in implementing the Mimi series. The math instructor wanted to move from a basic map and navigation course to one that incorporates actual orienteering exercises to be held on the school grounds. The other three teachers envisioned more of a constructivist approach in which cooperative learning played a greater role. It was this writer's impression that the teachers first hand experience with the series will allow them to expand the content or create supplemental activities congruent with the series. This will facilitate a closer fit between the curriculum and the Mimi series.

By Lorena Maria Aquirre, 7th Grade

One very important issue remains: were the students learning? In addition to anecdotal information, the students turned in end-of-exercise papers that resembled portfolios. An analysis of these papers showed that the students were wrestling with important concepts. Examples included, but were not limited to: human interaction with the environment--especially concerning endangered species; the social dynamics among the ship's crew members; the nature of variables dealt with by people with physical impairment; paleontology; and geography.

Discussion

In the opinion of this observer, the exercise results were extremely positive. Perhaps the results were caused by the novelty effect as Clark's 1983 writing would suggest, but the air seemed charged with excitement, engagement, and interest. The reader may be wondering what each teacher actually did in his or her classroom. There were four veteran teachers; the average years of experience was twenty. There was also a student teacher who had full planning and teaching responsibility for her section. The paper turns now to a short description of each teacher's classroom.

Math

The math instructor used the Mimi module entitled *Maps and Navigation*. The teacher followed the manual closely, having the students perform exercises involving, among other things, map making, measurement, distances, latitude/longitude, topographic maps, and triangulation. Math problems included ratios and time-distance problems. The latter supported work the students had been studying in their regular classes. During one exercise, the teacher went beyond the text's scenario by taking the students outside the school to estimate distances and determine azimuths (direction in degrees) by use of a compass. Both the teacher and the students were excited about this exercise. The instructor was overheard to say: "Golly, but it went well today--the kids loved it!" One female student remarked: **"This was just like in real life! It's something we don't have to learn for a test, then just forget!"**

Science

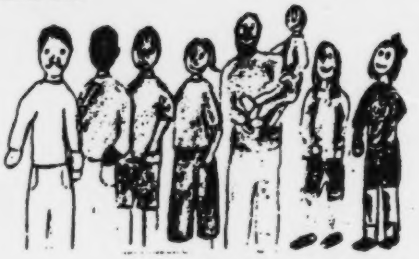
The science instructor used the Mimi module *Ecosystems*. The students studied food chains, food webs, and scientific methods. The students compared methods conducted by the

Mimi crew with those conducted in the forestry industry. They also had the opportunity to view and comment on some of the Mimi series' 13 videotape "expeditions" to places in which scientific activity was conducted. The students worked on group projects--conducting research in the library, then presenting a food chain depicted on a poster. There was also a written exit project for each student.

English

The English classes were divided into those taught by the regular teacher and those taught by the student teacher. The former started the students off by exploring the relationships of the crew members. She had the students keep daily journals--pretending to be an additional crew member. (The figure below contains a student's drawing of herself along with the rest of the Mimi's crew.)

The student teacher was fortunate in quickly finding a popular theme. One of the actors depicted in the series was hearing impaired. Once the student teacher found that some of her students were fully versed in sign language, she and the other students commenced to learn the entire alphabet in sign language. Their efforts culminated in an entire class taught using signing. The students taught the class--dividing into groups to help one another. The observer was struck with the patience and tenacity of the student teaching groups during this exercise. Toward the end of the Mimi experience, the section was visited by a speech pathologist. She discussed language as well as testing for hearing impairment. The student teacher ended her exercise by playing "Jeopardy" using Mimi terms and vocabulary.



By Erin Knocke, 7th Grade

Social Studies

The social studies teacher had expressed her reservations of such a wide-open approach to the classroom, but was soon struck by the students' interest in various themes offered by the Mimi series. The class conducted research on endangered species. Next, the class looked at paleontology--evaluating evidence that whales had evolved from land mammals. This led to the review of other evolution--looking for example, at leopards in transitory forms of evolution. Codes were explored; the class deciphered coded written messages and took down messages flashed in Morse code. This class also explored two other major topics: first, the formation of land/water configurations such as deltas, straits, and bays; second, the influence of Indo-European languages and their various branches.

Attitudes Toward Math and Science

Why didn't the exercise produce a change in student attitudes toward math and science? Looking at Table 1 above, the reader can see that there appeared to be a very healthy attitude toward math, and there was little gender difference. There may be a number of reasons for the lack of difference between genders. First, many of the children in the sample group came from families whose parents are staff or faculty at Virginia Tech; others were the children of professionals from Blacksburg, Virginia. It seems likely that these students would be college bound and more interested in math and science. The shortness of this exercise may have also contributed to no significant changes in attitudes. Mimi support materials indicate that the exercise could last for a semester, but these teachers only had time for an abridged version. Anecdotal written comments from the students, however, were extremely positive. The students were asked whether the next seventh grade class would profit from the Mimi series. Here are some examples of their comments:

- "...**I liked how all classes were incorporated with Mimi.**"
- "...it is educational, shows how important math and science are; it's an interesting way to do it..."
- "...it [helps] students open their eyes to what other areas of science, math, etc. there are."
- "It was different because the Mimi helped us **refer the things we learn to real life.**"
- "I enjoyed a lot of things in this but I think that **if anything should stay the same for sure, it should be that the sign language is taught again.**"
- "I would just like to thank the writers of this program because I had so much fun."

Another positive indicator was a question that asked the students what occupation(s) they had in mind. While not significant, there was a strong increase in selections of science teacher, marine biologist, and oceanographer.

Geography

One pleasant surprise to come out of the exercise was the unanticipated emphasis that developed in geography. Carstensen and Morrill (1992), in an unpublished paper dealing with a geography project at Virginia Tech, discuss the shortcomings of the nation's students in geography. They cite a need for students to have knowledge of the significance of location, the origins and development of places, and the consequences of the interactions between humans and the natural environment. In the opinion of this writer, the Mimi materials greatly facilitated addressing the types of knowledge discussed by Carstensen and Morrill. The students were learning geography while they were also engaged in the other disciplines.

Implications For Education

For those involved in educational research, the type of "anchored" environment looked at in this study provides lucrative areas for investigation. A particular challenge will be in developing appropriate evaluative tools conducive to constructivist environments. While this study took a "broad brush" look at the exercise, interesting areas for detailed scrutiny might include specific domain knowledge such as geography, science, or math. Others may be interested in the students' self esteem or stress levels. And there are always the issues of learning styles and learner differences.

Does the dramatic videotape series, *Voyage of the Mimi,* provide an effective vehicle for instruction? Yes. Within the concept of anchored instruction, it allows the instructor to pursue nearly all disciplines. It also provides the teacher with opportunities to take side trips into interesting and new areas while students are engaged in learning activities.

What did four veteran teachers think about the risk they took in using two weeks of their time to conduct this exercise? The reader can form his or her own opinion. The team plans to conduct the Mimi exercise during two weeks of the coming fall semester, and the school has purchased the series *The Second Voyage of the Mimi* for a two week exercise in the spring semester.

So until next time!
Bye
mimi

By Erin Knocke, 7th Grade

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Information Literacy meets Media Literacy and Visual Literacy

by
Ronald E. Sutton

...information is expanding at a rate that is at least 200,000 times faster than that of human population...The world population has increased fifty times since 500 B.C., (from 100 million to 5.2 billion people). The global information base has, in contrast, gone from about 10,000 pages of information to 100 billion pages. By the end of the 21st century, if exponential growth continues, we could even reach 100 sextillion pages of information.

[from ***The Globalization of Digital Information Services***, Dr. Joseph N. Pelton, Univ. of Colorado at Boulder, May 1991]

Information Literacy might be called the "new kid on the block." In 1989 the American Library Association's Presidential Committee on Information Literacy issued its appropriately "informative" report on this new phenomenon. Pointing to the emergence of an **Information Age** in the twentieth century, the committee raised a number of problems that relate to this issue.

As the opening quotation illustrates, information is growing at an astounding rate. The ability to store, organize and make such information available is also expanding. Yet this information may not be accessible to all on an equal basis. Without money or an appropriate institutional connection, many may be shut away from this fragmented information base. This impacts on personal growth to stay abreast of a changing job market, effective participation in our democratic form of government, and even remaining nationally competitive in an increasingly global economy.

The task of this paper is to examine current definitions of three literacies, **Information, Media, and Visual,** and to give specific guidance to those wishing to know more about them, from both a theoretical and practical standpoint.

INFORMATION LITERACY DEFINED

The ALA report weighs in with a first definition of this new literacy. "To be information literate, a person must be able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information." (p. 1). The report goes on to address the importance of information literacy to individuals, businesses and citizenship. The examples given in the business sphere are especially poignant as they indicate the problems that can emerge from managing with too little information, as well as too much. Equally important, though really just a recasting of the nation's 18th century founders, is the concern that American citizens have access to information in order to run their republic. Writing in the January 1976 edition of ***Library Journal***, U.S. Representative Major R. Owens puts the issue in succinct fashion:

> "Information literacy is needed to guarantee the survival of democratic institutions. All men are created equal but voters with information resources are in a position to make more intelligent decisions than citizens who are information illiterates. The application of information resources to the process of decision-making to fulfill civic responsibilities is a vital necessity." (p. 5)

PRESENT LEARNING SITUATION INADEQUATE

The report then focuses on opportunities for the development of information literacy and locates those possibilities and responsibilities in the libraries, colleges/universities, and schools of the nation. A grim picture is painted of the present learning environment:

> The quality of a college is measured by the resources for learning on the campus and the extent to which students become independent self-directed learners. And yet we found that today, about one out of every four undergraduates spends no time in the library during a normal week, and 65 % use the library four hours or less each week. The gap between the classroom and the library, reported on almost a half-century ago, still exists today (p. 6, 1986 Carnegie Report on Colleges).

The report argues convincingly that too much of today's educational process is pre-packaging information for student and consumer consumption. They point out that students carry away less than half of a lecture's content and usually forget more than half of that half in a weeks's time. What is needed is a " . . . new model of learning --- learning that is based on the information resources of the real world and learning that is active and integrated, not passive and fragmented." (*ibid.* p.7). The report stresses that what is needed is a new learning paradigm. One that ". . . would actively involve students in the process of:

- knowing when they have a need for information
- identifying information needed to address a given problem or issue
- finding needed information
- organizing the information
- using the information effectively to address the problem or issue at hand." (p.7).

INFORMATION AGE SCHOOLS NEEDED

A description of an information age school follows and we find its characteristics are that it is interactive; grounded in self-initiated learning; features teachers as facilitators, coaches, and guides, rather than information sources; fosters a high degree of cooperation among teachers, librarians, media resource people and instructional designers; displays assessment techniques that value process as well as product; provides community outlets for student work (such as cable television programs); and finally, the school would bristle with the ongoing display of original student/teacher projects about real issues in the real world (*ibid.* pp. 8 & 9).

The report concludes by claiming that among all the worthy calls for literacy--computer, civic, cultural, global (and one would have to assume media and visual)--information literacy is the most important. For, "Now knowledge--not minerals or agricultural products or manufactured goods--is this country's most precious commodity, and people who are information literate--who know how to acquire knowledge and use it--are America's most valuable resource" (*ibid.* p.10).

NATIONAL FORUM FOR INFORMATION LITERACY FORMED IN 1989

Among the recommendations made by the Committee was one to establish the Coalition for Information Literacy. In response to that suggestion the National Forum on Information Literacy was established in 1989. It is an umbrella organization to promote the concept of information literacy at the national level, and to encourage the dissemination of the rationale for information literacy through publications and presentations. Initial sponsorship came from the ALA and the Forum now includes more than sixty member organizations, one of which is the International Visual Literacy Association.

The Forum is under the very capable leadership of Dr. Patricia Seen Breivik, Associate Vice President for Information Resources at Towson Sate University, (Towson, MD), and meets every three months in Washington, D.C.

The Forum has worked on a variety of projects including:

- an endorsement of selected resolutions from the 1991 White House conference on Library and Information Services;
- a public relations campaign stressing the need for lifelong-learning in the information age;
- a partnership with the Educational Resources Information Center (ERIC) Clearinghouse on Information Resources, which will provide a repository for "information literacy" resources under one "electronic roof;"
- and the development, by Dr. Christina Doyle, of outcome measures for national education goals suggested by the National Forum.

The study by Dr. Doyle defined information literacy as "the ability to access, evaluate, and use information from a variety of sources." The outcomes were that an information literate person is one who:

- Recognizes the need for information;
- Recognizes that accurate and complete information is the basis for intelligent decision-making;
- Formulates questions based on information needs;
- Identifies potential sources of information;
- Develops successful search strategies;
- Accesses sources of information including computer-based and other technologies:
- Evaluates information;
- Organizes information for practical application;
- Integrates new information into an existing body of knowledge; and
- Uses information in critical thinking and problem solving.

A Delphi panel research technique was used to pursue this issue with 57 persons representing 20 national organizations. Dr. Frank Dwyer, Dr. Priscilla Hardin, Dr. Rhonda Robinson, and Life Member Don Fork, were the IVLA members that participated.

It is interesting to note that the **Information Literacy** movement is based on a given. That given is the public library system, which, in the United States, has made information available as a public service to citizens, many of whom look to the library last, not first, for such a priceless service. The need for and importance of technologically-sophisticated, information-sharing public libraries is central to the advancement of **Information Literacy** in the 21st century.

For an up-to-date list of member organizations and additional information, write the **National Forum on Informa-tion Literacy**, c/o Dr. Patricia Senn Breivik, 50 E. Huron St., Chicago, IL 60611. Telephone (410) 830-2498.

MEDIA LITERACY: A NEW TERM FOR OLD CONCERNS

Media literacy is the ability to decode, analyze, evaluate and produce communication in a variety of forms. (the Trent Think Tank on Media Literacy, Toronto, 1989.)

Put even more simply, this term means to **understand the media**. To understand the media is to be able to use it as a source of information, entertainment, enrichment, growth, empowerment, etc. Equally important to understand the media is to use IT rather than having IT use you.

Let's look at the Mission Statement of **STRATEGIES FOR MEDIA LITERACY**, perhaps the key organization in the United States working in this area:

- STRATEGIES FOR MEDIA LITERACY (SML) is a group of media professionals, educators and parents. As producers and consumers of mass media, we are concerned about media's role as informal teachers of values, their effect on consumer behavior and their function as major sources of information.

- SML believes that when people bring critical analysis skills to the communication process, they better understand the structure, content and function of the mass media and can make informed choices about media uses. Instead of passively receiving media messages, a media literate receiver can draw from a structured set of internal responses to media information. In this way, a single media literate receiver has as much power as the senders of information to use media as a tool for understanding.

- SML expands the traditional definition of literacy to include all forms of communication in the belief that each medium delivers essential information in unique ways. By pushing the definition of literacy past print to include electronic forms of communication, visual literacy and messages embedded in popular culture venues, we can more accurately address literacy needs for a diverse, multi-lingual society. As such, media literacy is one of the cornerstones of citizenship in a democratic society. (from SML Mission Statement - undated but circa 1988-91)

The other points in the mission statement of SML discuss the nature of how one acquires this type of literacy through education, ideally from childhood to the grave. This organization is effectively and efficiently guided by Kathleen Tyner, Executive Director. The organization does workshops, issues excellent publications useful at all stages of the educational process, and is a extremely reliable source of information about Media Education in the U.S. and the world. Write for information and membership to SML, Inc. Ste. 410, 1095 Market St., San Francisco, CA 94103; (415) 621-2911.

BEYOND SML: ADDITIONAL MEDIA LITERACY GROUPS

While many of us in IVLA know Kathleen best (she attended the conference in Arizona and has featured IVLA members, such as Lynn Lacy, in her quarterly newsletter, STRATEGIES), she herself points to others at work in this field.

One such group is the **National Telemedia Council**. It began in the 1930's and was originally a response to the new medium of radio and its impact on society. They tried then, and now, for awareness, critical evaluation, and appreciation of quality programming. Perhaps best known for their **Look-Listen-Learn Project** this is obvious another source of support and guidance for teachers and consumers looking for media literacy help. Write Marieli Rowe, Ex. Dir. National Telemedia

Council, 120 E. Wilson St., Madison, WI 53703; (608) 257-7712.

Another group is the **Center for Media and Values.** They describe themselves as "The Leading Resource Center for Media Literacy Education" and their Executive Director, Elizabeth Thomas, explains what they do: "Helping people become selective and aware media users is the mission of the Center for Media and Values. It is the premise behind our award-winning quarterly, ***Media and Values***. It is the backbone of every educational resource we offer. We call it media literacy" (p. 2 Catalog of Center).

The concern here is for elementary and high school curriculums, but also for youth programs, adult education classes and community programs of all types. They offer membership, the magazine, lots of interesting materials, and under the heading of "Why Media Literacy is Important to All of Us," their catalog contains a slightly edited version of the 1982 Declaration on Media Education from UNESCO! Write 1962 S. Shenandoah, Los Angeles, CA 90034; (213) 559-2944.

U.S. NOT THE LEADER IN MEDIA LITERACY

England has had media education for years. Our IVLA 1990 Symposium in London was undergirded by people who were involved in the Media Literacy movement in the United Kingdom. Australia also has media studies in its school curriculum. We heard about this movement in some detail a few years ago from Australian pioneer media educator/expatriate David Considine, (a former IVLA member & organizer of our Madison, Conference), who is a professor at Appalachian State University in Boone, N.C.

Unfortunately, while the United States has the most mass media, it has the least amount of training in it for both students and teachers. Our neighbor to the North, Canada, has taken some steps to remedy this situation in their country. In 1987 it was decreed that all schools, grades 7-12, in Ontario Province, must teach media literacy. This has led that area to be a hot bed for the production and consumption of Media Literacy materials, conferences, and opinions. Barry Duncan is a high school teacher and the founder-President of the **Association for Media Literacy** in Ontario. Over several years a series of conferences have been held in Ontario focusing on such issues as:

- combatting "back to basics" pressure;
- trying to help educators and administrators understand the difference between teaching **through** the media and teaching **about** the media;
- dealing with budget crunches;
- finding resourceful material;
- and eternally arguing about the definition, focus and scope of media literacy.

Dr. Patricia Aufderheide, a senior editor of ***In These Times*** and my colleague at The American University, attended the most recent conference held by the Association for Media Literacy. It took place May 13-15, 1992, in Guelph, Ontario, Canada. Her stimulating and cogent review of the conference was published in the September 1992 edition of ***Afterimage***. It's an excellent analysis of some of the strengths and weaknesses of the media literacy movement in its present incarnation.

For information, write The Association For Media Literacy, 40 McArthur St., Weston, Ontario M9P 3M7; (416) 394-6990.

Media Literacy is important and needed. The author has been teaching a course, Understanding Mass Media, for 20 years at American University. The course is designed to help students understand the structure and function of the various media of profit, information, persuasion, and entertainment in the United States. Our faculty want students to understand that all media is a construct, created for a purpose (primarily profit in the U.S.). When asked for a rationale for the course we were going to team teach in 1989, my previously-mentioned colleague, Patricia Aufderheide, responded with the following questions to present to our students:

- Who sets the agenda for the information we get? What's objective, what's fair, what's enough?

- What relative roles do economic, social and political forces play in shaping the context for what journalists and entertainers produce? How do regulation, history and social/moral values shape our media?

- To what extent does form dictate content? Is the medium the message in TV? Can films deliver a powerful argument without expressing it in emotional terms?

- Do mass Media shape social issues (a top-down model) or do they respond to public desire (a supply-demand model)? (Memo May 22, 1989).

These are excellent questions and can engage us at every level of discourse in the educational community. The bottom line is that the media as a force in our society and world are far to important **not** to be studied.

√VISUAL LITERACY: 25 YEAR OLD YOUNG ADULT

In ***Webster's Ninth New Collegiate Dictionary***, (1983), the definition listed for Visual Literacy is as follows:

"visual literacy **n** (1971): the ability to recognize and understand ideas conveyed through visible actions or images (as pictures)."

There is no similar listing for media literacy or information literacy. Note the 1971 origin. Presumably this term or combination of terms just didn't exist before IVLA founder, Jack Debes, coined its use around that time. However, dictionary definitions don't really explain what the International Visual Literacy Association has been up to since it was incorporated in 1969.

Our official definition, shaped largely by the thought of pioneers Jack L. Debes and Clarence M. Williams, remains:

> - Visual Literacy refers to a group of vision-competencies a human being can develop by seeing and at the same time having and integrating other sensory experiences. The development of these competencies is fundamental to normal human learning. When developed, they enable a visually literate person to discriminate and interpret the visual actions, objects, and/or symbols, natural, or man-made, that [are encountered] in [the] environment. Through the creative use of these competencies, [we are] able to communicate with others. Through the appreciative use of these competencies, [we are] able to comprehend and enjoy the masterworks of visual communication. (Official IVLA brochure based on p. 39, Provocative Papers Series #1; ***Visual Literacy, Languaging, and Learning***, Debes/Williams).

IN DIVERSITY THERE IS STRENGTH

What this really amounts to is a mandate to examine visuals as a language and communication system. For twenty five years the members and friends of IVLA have been doing this in the pages of the newsletter, the journal, the readings, at conferences, symposiums and regional gatherings. IVLA is a wildly diverse group. Our numbers include fine and graphic artists, scientists, photographers, researchers, film and video makers, business communication professionals, school administrators, print and electronic journalists, visual anthropologists, educational technologists, and educators at all levels. It is a fascinating if roller-coaster sort of history. The enormous repository of ideas, lots of it now being gathered safely and carefully into the Visual Literacy Collection at Arizona State University, testifies to our diversity. Of course it is this diversity that makes it difficult to define and explain what exactly our organization is all about, or what our wonderful "circus tent" of a term, **Visual Literacy**, really means.

This doesn't really bother me too much. Lack of precision and willingness to include eclectically a wide range of ideas seems a strength. For example, I describe the controlling purpose of our Visual Literacy courses (9 sections of 30 students annually) at The American University as follows:

> - To assist students in understanding visual imagery, providing a wide range of experience so they may learn to "see" in a discerning manner. To help students understand that visual literacy is the awareness of the image and sound as a series of production decisions on the part of artists and producers. To challenge students in their understanding of the social, cultural, and political context in which visual images are used to achieve a variety of goals. (Sutton course syllabus -1992)

One sees traces of the basic Visual Literacy definition here but it is adapted to a course that exists in the Arts Area of a University General Education Program taught by a group of professors from the School of Communication.

CONCLUSION: MULTI-LITERACIES FOR A MULTI-CULTURAL WORLD

Thus, we see that **Visual Literacy** as concept and organization is 25 years old next year; **Information Literacy** as a National Forum is four years young; and **Media Literacy**? In different form the beginnings of media literacy reach back to the Payne Fund Studies of the 1930's. The concern in those early days was to guard our society, especially children and youth, from being corrupted by the evils of the newer media. Similar concerns surfaced again in the Sixties.

One of the prophets of this period was the Canadian scholar and teacher, Marshall McLuhan. He stood in the valley as the decade began and announced to all who would listen that there was a huge truck at the top of hill full of popular media and messages that was going to run over and smash our culture. For his trouble many accused him of driving the truck!

Many of us in the Media Education movement of the 60's, a movement which peaked around 1974 with 25 regional groups composing the now-defunct National Association of Media Educators [NAME], (the author was the founding Executive Secretary, 1970-73), saw media as a positive force, but worried about its ability to manipulate even those of us who enjoyed it used it and studied it. There was little in our theoretical foundation, one admittedly as shallow as other dimensions of the 60's, to shield us from the devastating effect of McLuhan's truck.

There is still little attention to theory in the current **Media Literacy** movement (c.f. Aufderheides' article in ***Afterimage***). We need to ask questions about the purpose and ultimate goal of this literacy, even as we also query exactly what those interested in furthering **Information Literacy** have in mind. So far the careful thought behind the founding statement is strong, but the basis for extension has little depth in theory and concept beyond practical applications, e.g. lifelong learning by whom, for what purpose, paid for by whom, for what reason?

Visual Literacy has endured some twenty five years of being defined and re-defined. That process has led to the wise stance of looseness and eclecticism. No rigid ideology here---more an accepting attitude until certain elements (such as computers) are incorporated, and others (teaching machines) are sloughed off or relegated to lesser positions of importance.

And through it all, rather than the desire to create a steamroller of a educational or political movement, a quiet, intense, dedicated, informative, band of folk have raised a concept of a new type of literacy into the consciousness of the nation (remember the dictionary). Helping all people cope creatively with the new and exponentially expanding world of media seems to require all these literacies and maybe new ones that await us in the 21st century.

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Examining Visual Verbal Relationships

by
Roberts A. Braden

Definitions:

The word "visualize" is a verb. Its noun form is "visualization." The root word "visual" is listed in the dictionary as an adjective, but not as a noun. Thus adjectivally we speak of the visual properties of objects, visual metaphors, visual skills, visual flight rules, and, yes, of visual language and visual literacy. Thus while visual is not listed as a noun, common usage will soon change that.

In education and the visual arts we now speak of visuals when we mean visual aids, or when referring to images of many kinds that are used to communicate. As a pseudo-noun visual is somewhat synonymous with image, picture, and illustration. In fact, the word visual has been used as a noun substitute for chart, graph, diagram, painting, and sketch.

For the purpose of this discussion, let us consider visuals to be *things that can be seen, things viewable, visible things other than printed words that are used in a communication process.* Clearly, the sense of sight is central to the concept of a visual.

Like visualize, "verbalize" is a verb. The adjectival form is "verbal", and "verbalization" is the comparable noun with regard to the preceding discussion. No pseudo-noun usage of the term verbal is common, however, so a complete analogy between the terms cannot be constructed. Thus, to facilitate discussion the term verbal will be used hereafter not only as an adjective, but also as a noun, meaning verbal elements of any kind.

Unlike "visualize", the term "verbalize" is most often associated with the acts of speaking and listening, and therefore is most closely related to the sense of hearing. But it is language, not the sense of hearing, that is central to verbal things. The operational definition must be extended so that *verbal applies to written or spoken words, linked to either or both of the senses of hearing and sight.*

Jack Debes, the father of the visual literacy movement, and others (e.g., Pettersson, 1989) have referred to *visual language*. At the extreme, a visual language would imply a stand-alone grammar and a vocabulary of images, symbols and icons that are independent of the spoken and written language in general use.

After a luncheon speech given by Debes in which he extolled the notion of visual language, he was asked to give an example of a truly visual language. He responded that American sign language was a highly developed visual language, but conceded that it really was only a different way to "write" (with gestures) the English language. Pressed further he identified the captionless cartoon (he named the now extinct comic strip *Henry)* as an example of the use of visual language.

Pettersson says, "Symbols and pictures could be referred to as 'visual languages'." and he notes that "Paintings, drawings and other objects of art often stand alone." (1989, pp. 202-3). Mostly, however, Pettersson deals with visual language only as a theoretical concept. He plugs visual language into a theoretical model in which three kinds of language -- verbal, audial, and visual -- are found in combinations.

Consequently, Petterson's model results in the coining of new terms: **audio-verbal** refers to combinations of verbal language and audial language; **verbo-visual, oral-visual, and lexi-visual** all refer to combinations of verbal language and visual language; **audio-visual** represents the combination of audial language and visual language; and the combination of all three kinds of language is designated as **verbo-audio-visual.** For practical everyday use, Pettersson simplifies his theory thusly, "Based on how the *verbal information* is presented to the receivers we can distinguish between two forms of verbo-visual information. We *read* text in **lexi-visual** representations and we *listen* to speech in **audio-visual** representations..." (Petterson, 1989, p.204)

Visual Verbal Relationships in General

The above definitions of visual, verbal and related terms may be subject to dispute. Shades of meaning exist. However, those definitions are offered here because our purpose is not to quibble about shades of meaning, but rather to be clear about the meanings denoted as we examine the relationships between the visual and the verbal. Sometimes those relationships are strong. Sometimes weak. In general, though, we can summarize all of the relationships between visual images and verbal elements with the conclusion that images complement words and vice versa.

That natural tendency for visual and verbal components to be mutually supportive has been called *visual-verbal symbiosis* (Braden, 1983). When an image is mislabeled or words are not correctly illustrated or when there is any other instance of showing one thing while saying another, the natural relationship is destroyed and the result is *visual-verbal discontinuity*. The purpose of this paper is to concentrate more on the symbiotic relationships than the discontinuitous ones.

Types of Visuals:

Visuals are categorized in several ways. They can be categorized by size: small, medium, and large. Or, they can be classified according to the end purpose: educational, promotional, entertainment, art. Or, visuals can be grouped according to the roles that they play relevant to text. Or, visuals can be sorted according to content. Visual literacy enthusiasts have found these and other classification systems useful.

Still another useful categorization scheme is one that groups visuals by outstanding characteristics of the visuals themselves. For instance, the terms static, dynamic, and personal may be assigned as categorizing rubrics.

- **Static visuals** include pictures and other printed or projected images
- **Dynamic visuals** include animation, video, and film
    - ○ **Personal visuals**, a subset of dynamic visuals, include pantomime, sign language, body language, and gestures

Following the same line of reasoning verbal elements can be categorized into one of two major classes, static or dynamic.

- **Written (Static) verbal elements** include words (text) in all of their forms, printed or projected. When numerals and other mathematical symbols are used as language they are included in this category.
- **Spoken (Dynamic) verbal elements** include the spoken language in audible form and visible forms of text that are metamorphosed or animated.

To create a useful matrix which displays the interactions of germane variables we need to ask which factors are known to support which others and to record how that support might be provided. In that context, the following matrix (fig.1.) is offered which is more a description of the possible interactions than a set of ultimate examples.

The simplicity of Figure 1 is its greatest weakness. Obviously the cells are filled with only a few of the many examples that might have been chosen. More critically, the categories are so broad that only the broadest generalizations could be made. What about the degree of realism in visuals (see Knowlton, 1966; Levie, 1978; Levie and Lentz, 1982; Dwyer, 1968, 1978 and later), the degree of visualization versus the degree of verbalization (Wileman 1980, 1993, Braden & Beauchamp, 1987), and the characteristics of the particular visual genre, e.g., outline graphics (see Braden, 1982)?

Degree of Realism:

The most extensive research that has been done in the field of visual literacy has been the twenty-odd year series of experiments conducted by Francis Dwyer and his associates known as the Program of Systematic Evaluation (PSE). In one way or another most of the PSE experiments have been related to a set of visuals that depict the human heart. The illustrations range from realistic color photographs of a real heart to sketchy black and white line drawings. They span the spectrum of reality which can be displayed in printed images. Many of the experiments sought data on the effects of these images as they interact with verbal components such as labeling, parallel printed text, and oral commentary.

Degree of Visualization v. Degree of Verbalization:

Comic books are mostly picture stories with the dialogue of the principals lettered into speech balloons. Text books are mostly written sources of information with appropriate pictorial and graphic materials scattered around. The possibilities are endless as far as the ratio goes of visual to verbal material present in a book or magazine. For the most part, the role or purpose of the publication determines the ratio. The

Static Visuals	n/a	Rare. Use of video as a guide to an art museum.	Yes. Slide + Tape. Mediated lecture. Show and tell.	Yes. Story boards. Figures and pictures in newspapers. Magazine ads.
Dynamic Visuals	Yes. As objects shown in the dynamic medium, e.g., a chart in use in a filmed lecture.	n/a	Yes. The commentary which accompanies the pictures on the evening news.	Yes. Superimposed explanations on TV, e.g., the names of speakers on interview shows. "Crawl" messages at the bottom of the screen.
Spoken Verbals	Yes. Diagrams used in a chalk talk. Slides shown during a lecture. Charts used during a briefing.	Yes. The pictures which accompany the commentary on the evening news.	n/a	Yes. Handouts at a speech, lecture, or meeting.
Written Verbals	Yes. All kinds of images in books and journals which illustrate the subject of the text.	Unusual. A video or film of a story being taught as a book in a literature course.	Yes. A lecture which explicates a printed handout. Any speech which explains printed information.	n/a
Supported by →	**Static Visuals**	**Dynamic Visuals**	**Spoken Verbals**	**Written Verbals**

Figure 1. Matrix of support relationships with selected examples.

final ratio is determined as an editorial decision. You are looking at an example of how the purpose drives that editorial decision. Rational thought would lead us to expect that the editorial decision regarding *this textbook* would be to have a relatively high ratio of visual material to the verbal content. Would the same decision be made if this were not a book about *visual* things? Probably not.

Visuals and verbals can be combined in any ratio -- lots of one, lots of the other, or lots of both. An interesting (and challenging) set of possibilities occurs when the ratio involves visual and verbal elements displayed together in one medium. Posters, printed ads, billboards, computer graphics, and TV commercials are but a few of the examples we encounter daily wherein visual and verbal elements are displayed concurrently.

Ralph Wileman has created a typology of verbal and visual image relationships. In his earlier work (Wileman. 1980) he called his seven image types "slides." Thus at one end of his spectrum were what he called reader slides which were basically images of words -- purely verbal. At the other extreme were pictorial or graphic symbol slides which were devoid of any typographical enhancement -- purely visual. In his most recent version of the typology (Wileman, 1993), he uses the term "frame", reflecting the fact that slide-lectures and slide+tape presentations are giving way in popularity to lectures illustrated with computer graphics and other forms of computer driven presentations (fig. 2).

Type I:
READER frame (pure verbal)

Type II:
EMPHASIZED READER frame

Type III:
Reader frame with VISUAL CUES to meaning

Type IV:
Verbal/Visual BALANCED frame

Type V:
Pictorial or Graphic Symbol frame with VERBAL CUES to meaning

Type VI:
EMPHASIZED PICTORIAL or GRAPHICS Symbol frame

Type VII:
PICTORIAL or GRAPHIC Symbol frame (pure visual)

Figure 2. Wileman's Typology

Figure 2 is a listing of the types of frame that Wileman includes in his continuum. The bold lettering and capitalization cues in the text of the figure represent Wileman's (1993) own emphases.

What Wileman has done is to identify the extremes, the middle (visual/verbal balanced frame) and then created arbitrary categories representing other degrees of dominance of either the visual or verbal component. His examples are appropriate, and the result is an extremely useful theoretical model.

Braden and Beauchamp (1987) approached the categorization task from an audio-visual perspective. The particular medium they chose to exemplify their theory was the slide+tape. Consequently, they established two continua: one for what is seen, the other for what is heard. In contrast, Wileman's typology considers only what is seen. The four extremes of the two variables in Beauchamp and Braden's model are displayed as a 2X2 matrix in Figure 3 on the next page. The matrix could, of course, have been expanded to show all seven of Wileman's types of slides (frames) and a comparable number of types of sound ranging from completely non-verbal to completely verbal. However, the resulting chart would have contained forty-nine cells and would have been much more difficult to comprehend.

The typical slide+tape program contains a mixture of slide types and a mixture of sound variations. As a result, it is clear that an infinite number of possible combinations exist, and the relationship of visual to verbal elements in any given program is

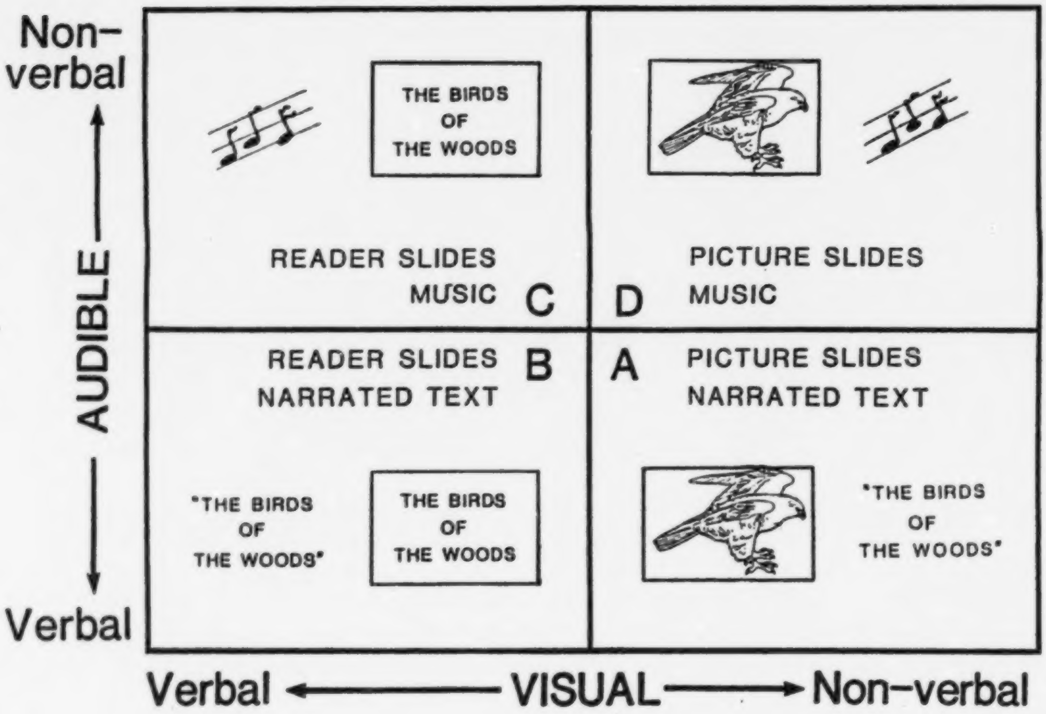
Non-verbal
AUDIBLE
Verbal
THE BIRDS OF THE WOODS
READER SLIDES
MUSIC
C
PICTURE SLIDES
MUSIC
D
READER SLIDES
NARRATED TEXT
B
A
PICTURE SLIDES
NARRATED TEXT
"THE BIRDS OF THE WOODS"
THE BIRDS OF THE WOODS
"THE BIRDS OF THE WOODS"
Verbal
VISUAL
Non-verbal

Figure 3. Beauchamp & Braden's 2X2 Visual-Verbal Matrix

determined in large part by the purpose of the program and the preferences of the designer.

The Role of the Visual:

Duchastel (1978) pointed out three roles of illustrations in text: the *attention role*, the *explicative role*, and the *retention role*. In order, the first role or purpose is to attract or motivate, the second to explain (show) that which is difficult or impossible to describe, and the last is meant simply to be memorable.

All of Duchastel's three roles can be applied to the uses of text in learning, but they are equally appropriate to the field of advertising, to business communications, and other textual applications. In essence the role of the visual is a projection of the intent or purpose of its creator. That being the case, let us simplify to a single role, i.e., that *illustrations in text are usually there to support the text* (and the text carries the author's message and agenda -- whatever it may be.) The rare exceptions are art books and specialized pictorial books where the role of the visuals is to *be* the message and to carry the author's agenda.

Duchastel and Waller (1979) indicated that we need "...a set of principles which relates illustrations to the potential **effects** they may have on the reader or learner." Wiley's Hierarchy of Visual Learning contends that the **effect** of visuals upon verbal information is a function of the visual maturity of the viewer (Bertoline, Burton & Wiley, 1992).

The Printed Word

Of the many media combinations which bring visual material together with verbal elements, by far the two most influential and widely utilized are the printed page and the video screen. Of the two, the printed pages remains the clear leader in terms of the amount of visual-verbal information disseminated. Print remains, therefore, of central concern to students of visual-verbal relationships.

Several major books have been written recently on the topic of text, and each devotes extensive coverage to the visual aspect of displaying text (Jonasssen, 1982, 1985; Hartley, 1985; Gropper, 1991). "Text," of course, refers to **words** displayed in any of several printed forms, including books, magazines, newspapers, letters, pamphlets, and so forth.

A few books have also been published recently that deal specifically with displaying **visuals** in print. Commendable amongst the latter group are the books of Pettersson (1989), Tufte (1990), Willows & Houghton / Houghton & Willows (both 1987). These books deal directly with the visual-verbal relationship. The books in the "text" category are all concerned with **visible language** itself, i.e., all of the visual aspects of written language.

Visible Language is defined here as any written or printed example of a verbal language -- in any visible form. Today we have viewable electronic and projected displays of verbal language in addition to books, newspapers and the like. As we think about the relationships of the visual to the verbal, there are four aspects of visible language that immediately come to mind. They are: typography, typographical cuing, printing conventions, and format & layout (page design).

Typography is concerned with the design, appearance, and use of typefaces--that is, the size, shape and placement of letters on the printed page. It is concerned with how letters fit side-by-side (kerning), with line and word spacing, with fonts and more. In short, there is an entire profession out there which is devoted to the visual aspects of letters and printed words. Typography is part of *visible language*.

Typographical cuing consists of a variety of visual techniques which are used in printing to direct the attention of the reader. Visual impact is gained through the use of capitalization, font size, underlining, italics, boldness of letters, lines, rules, arrows, bullets, and even of the use of white space on the page or screen.

Printing conventions are the "rules" which govern letter placement and other visual considerations during printing. When cuing is artfully combined with printing conventions, the visual aspect of typography may take on near-equal status with the verbal component. We take these conventions for granted until we see them violated. Consider the following block of text:

> SeLeCtEdPrInTiNgCoNvEnTi
> OnSHeAdInGsSkIpTwOlInEsP
> rIoRsKiPoNeLiNeAfTeRsEtOf
> FwItHcUInGwOrDsPaCeBeFo
> ReAnDaFtErInItIaLcApItAlIzA

tIoNfOrPrOpErNoUnSpHrAsE
bIuNdArYpUnCtUaTiOnExTr
AsPaCe*SeNtEnCeBoUnDaRy
InItIaLcApItAlIzAtIoNfInAlPu
NcTuAtIoNmArKsExTrAsPaC
e*PaRaGrApHiNdEnTaTiOnSk
IpAlInE*bOlDfAcEiNiTiAlCh
ArAcTeReNlArGeDeTceNdOf
LiNeRiGhTaNdLeFtJuStIfIeDh
YpHeNInDiCaTeSwOrDdIvIsI
oN*iNbOoKsUsUaLlYnObEcO
nSiStEnT

The information in that string of letters can be made much more readable if we observe only three printing conventions--those of capitalization, punctuation, and word spacing. (See the next example.) While we may still experience difficulty deriving clear meaning from this block of text as a whole, at least we can easily read the words and phrases.

SELECTED PRINTING CONVENTIONS Headings Skip two lines prior Skip One line after Set off with cuing Word Space before and after Initial capitalization for proper nouns Phrase boundary Punctuation Extra space* Sentence boundary Initial capitalization Final punctuation marks Extra space* Paragraph Indentation Skip a line* Bold face, initial character enlarged, etc.End of line Right and left justified Hyphen indicates word division *In books, usually no. Be consistent.

The string of letters makes more sense as a string of words, but even more meaning is possible when the words are powerfully displayed. For example, you can add visual cuing and arrange the words into a display format to create an all-verbal figure that draws much of its strength and meaning from the layout, the fonts, the bullets, or other sight cues. Figure 4 illustrates how one might display the information in our example at hand. Any number of equally effective or more effective layouts are possible.

**SELECTED
PRINTING CONVENTIONS**

Headings
- ▸ Skip two lines prior
- ▸ Skip one line after
- ▸ Set off with cuing

WORD
- ▸ Space before and after
- ▸ Initial capitalization for proper nouns

PHRASE BOUNDARY
- ▸ Punctuation
- ▸ Extra space *

SENTENCE BOUNDARY
- ▸ Initial capitalization
- ▸ Final punctuation marks
- ▸ Extra space *

PARAGRAPH
- ▸ Indentation
- ▸ Skip a line *
- ▸ Two or more sentences

END OF LINE
- ▸ Right and left justified
- ▸ Hyphen indicates word division

* In books, usually no. Be consistent.

Figure 4. Example of visualized display of printing conventions (see Braden, 1982; Haber & Haber, 1981; and Lenze, 1992)

An obvious attribute of figure 4 is the hierarchical structure of the content. Because the information is outlined, it can be abbreviated and displayed as shown. The outline graphic is a particularly powerful form of visible language.

Outline Graphics:

An outline graphic (OG) is any outline done in any graphic form (Braden, 1982). Outline graphics are worthy of special consideration in the discussion of the relationships of visuals to verbals. To begin with, the outline in any of its forms is essentially verbal. A graphic is essentially visual. The OG retains all of the content features of the simple textual outline and enhances them by embellishing the way in which they are displayed. The essential characteristics of OGs are that they are **skeletal, orderly, holistic,** and have a **visual** component [see figures 5 & 6].

These two examples of outline graphics are designed to illustrate how the same content may be graphically presented in various ways. Figure 5 is dominantly verbal. The only distinguishing visual enhancements are the box in which the words appear, the use of more than one type size, typographic bullets, and indenting. The same words appear in figure 6, but the visible hierarchical arrangement of figure 5 has given way to a networked display with a focus upon one central concept.

Conclusion

Only a few of the many relationships of visual components to verbal ones have been explored in this paper. The examples given, were chosen to illustrate that ideas can be delivered with greater impact when the visual and verbal components are mutually supportive. Even left-brained verbal thought can be enhanced with right-brained visual structure. Even right-brained art can be enhanced by strong verbal description.

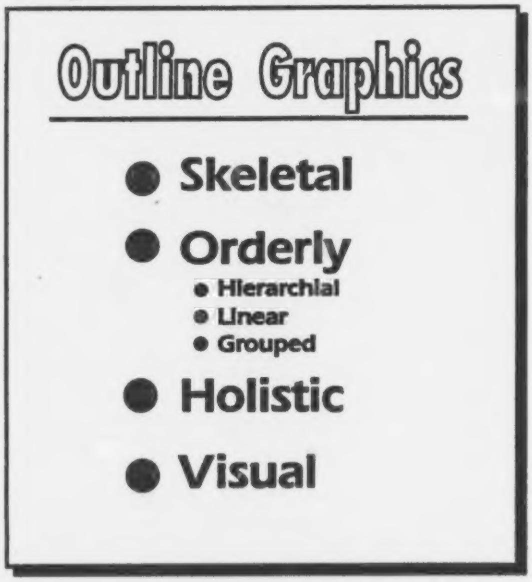

Figure 5. Minimal Outline Graphic

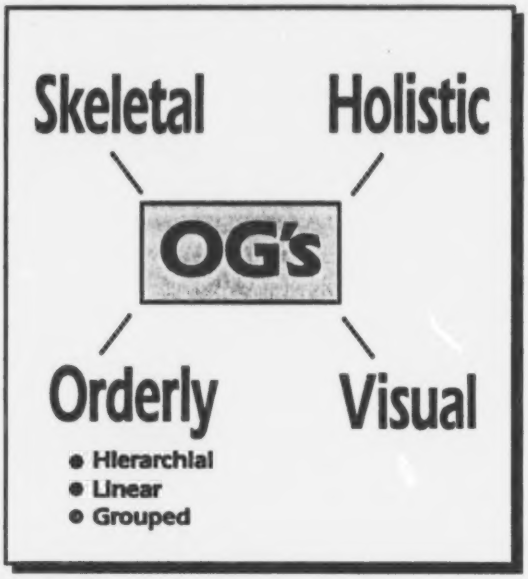

Figure 6. Outline Graphic with holistic emphasis.

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Aural-Visual-Kinesthetic Imagery in Motion Media

by
David W. Allan

Introduction

There are some interesting characteristics in the nature of film and television and the imagery they convey. The author identifies four kinds of imagery commonly found in motion media, namely, aural, verbal, visual, and kinesthetic imagery (A-V-V-K imagery). This discussion includes the role of imagery in film and television, the human mind and mental models, and symbolism in motion media.

Motion Media, inclusively, refers to film, television, and other forms of kinethetic media including computerized multi-media technologies and virtual reality. Imagery in motion media, in this context, is more than mental and emotional processes. It is a semiotic system that influences the aesthetic nature, expression, and interpretation of kinesthetic media.

The Nature of A-V-V-K Imagery
Definition

The nature of imagery, like perception and other mental processes, builds upon certain phenomenological attitudes or positions like nature, purpose, function, flow, relationships, time, and space. Imagery is what we think we can perceive; they are mental representations, symbolic thoughts, and conceptualizations of experiences in life. One of our most common experiences is with media, especially motion media. What is the imagery in motion media like?

Properties

Aural-verbal-visual-kinesthetic or A-V-V-K imagery, in my view, is—historically—the primary forms of imagery in media. How does A-V-V-K imagery work and what are its properties? A-V-V-K imagery in motion media initiates and guides human thought by delineating and deciphering the code and language of the media it enhances. Message content and meaning in motion media and the emotions it produces are influenced by an individual's scholastic, cognitive, emotional and ideological history. The continuous development of a self-perceptual history instantly reframes the smallest detail in A-V-V-K imagery—thus building a personal repertoire of imagery (Allan, 1991).

How are personal repertoires of imagery constructed? Edmund Bolles (1988) said the symbolic essence of imagery reappears in the forefront of human memory, instantaneously and without effort. When triggered by other related or associated representations in life, imagery, in all its forms and all its degrees, reaches emotional, factual, and interpretive levels.

The coded imagery of language symbolically represents meaning in life, culture, and society. In the rhetorical structure of language and dialog—and against the textual fabric of aural, visual and kinesthetic activity—much-sought-after mental imagery is conveyed. Content, story, and plot, through the magic of motion media, seek to satisfy the emotional and communication needs of individuals and groups.

A-V-V-K Imagery

Aural imagery should be looked at first. Aural information comes to the individual in the form of sounds, music, and spoken words. Aural imagery, generated and expressed, is a merging of non-verbal sounds and articulated vocal expression. Sound effects, created and performed in a recognizable form, communicate to the audience dramatic effects, aural coloring, and emotional feeling. The linkage of silent space, volume, and timing—where appropriate—produces an audio and visual sensation of combined energies.

Next, then, is verbal imagery. The heart of our rhetoric, the spoken and written word, comes from our language, English. Words, as codes, identify and label people, places, ideas, feelings, and things. In these codes, words and word combinations in sentences strike and form verbal imagery, developing a feeling or expressed emotion in the language of our culture.

Visual imagery, like aural imagery, exceeds its own capacity of meaning. We see visual imagery everywhere—during each hour we are awake. Our eyes have an enormous capability to see and transmit sophisticated images to the brain. The dominant sensory form in motion media is the visual because of its enormous capacity to hold and display information, and because of its many nuances and intricacies.

Motion media is more than the sum of its individual A-V-V-K imagery forms: there is a global unfolding of many phenomena within the viewer-recipient. Communication theorists Wilbur Schramm and de Solo Pool (1973) maintained that "The process of manipulating images and attempting to derive meaning from the interrelationship of images and sounds is basic to the nature of the medium" (p. 560). Movement of characters and physical objects and the images and messages they make within the medium intersect to form a union of aural, verbal, visual, and kinesthetic imagery. Some forty-five years ago the great Russian filmmaker, Sergei Eisenstein, understood that the development of an image or a film scene by the producer-director was not all there was to filmmaking. Eisenstein (1947) said, in his book *The Film Sense* , ". . . the image of a scene, as sequence, of a whole creation, exists not as something fixed and ready-made. It has to arise, to unfold before the senses of the spectator" (p.91).

Consequently, as a result of the mix of A-V-V-K imagery, different phenomena take place. The development of a personal repertoire of imagery begins at an early age as a viewer-recipient of motion media information. Filmic development and the ability of the viewer-recipient to internalize such sensory experience, causes a *synthesis* of imagery to emerge—immature at first, but more sophisticated as we grow older Allan (1991).

There is another phenomena that occurs when imagery is used in media. A *synesthesia* occurs when a sound or a musical passage causes us to visualize a scene or a particular personality characteristic. For example, the crackling noise of an exploding, roaring forest fire; the gentle, delicate smile of a beautiful-handsome person. The synthesis of imagery and the iconicity of image events cause a series of mental acts to occur. Ideas (abstract or concrete), thought patterns, sensory experiences, spatial, and temporal activities all lend themselves to mental model configurations (Allan, 1991).

Motion media present factual, well-paced, voluminous amounts of A-V-V-K imagery for the mind to process, to store, and, later, to recall. Not all gets through, however, at least not consciously. Noise and external forces may cancel even the slightest level of meaningfulness in the image event or in the informational increment. Redundancy and repetition of similar imagery and memory events help to reinforce and reinstate memory of the sensory experience.

A-V-V-K imagery, the real substance of media and the communication process, holistically becomes a *meta-phenomena*, a phenomena within phenomena. The orchestration of A-V-V-K imagery produces its own kinesis and symbiosis. In the whirlwind of the phenomena of communication, the mix of A-V-V-K imagery and the memories that follow their reception and perception, merge with other communication phenomena to disperse themselves in various serial, parallel, or scattered patterns. The internal mix of one phenomena within another is called meta-phenomenology (Allan, 1991).

The Human Mind - Mental Models

The human mind is something more than a mechanism that merely processes sensory experiences and mental imagery. Consciously and sub-consciously, the mind is an active participant before, during, and after the viewing experience. The kinesthesis of human mental behavior is unending. In and of itself the human mind is heuristic in form.

In John C. Yuille's (1983) book, Imagery, Memory and Cognition—Essays in Honor of Allan Paivio, psychologist Albert N. Katz recognizes Paivio for his contribution to visual imagery and the mind. Katz said Paivio comes as close as any theorist to a fresh understanding on how imagery and the mind works. Allan Paivio (1971) suggested that the mind follows three mental imagery operations, encounter, mediation, and instruction. By this he means that the mind instructs itself in deciding the importance of various images and their meanings.

A pioneer in cognitive psychology, mental imagery, and film theory, Allan Paivio (1975) referred to mental instruction as a mediational process, whereby encoded imagery serves to influence. In this cognitive operation, Ian Begg (1983) speaks of traces, trace use, and trace contacts as basic structural units of the memory process. The author calls these memory units iconic memory units, or IMU's. Other researchers label them as "thought-messages" and "word-images".

Psychologist Philip N. Johnson-Laird (1983) stated that mental models are *"recursive mental processes* that enable human beings to understand discourse, to form mental models of the real and the imaginary, and to reason by manipulating such models" (p. xi).

The medium does affect the message. Jerome W. Bruner et al. said a person's "ability to think develops with the tools and media he/she uses and that the mind models these media" (1966, p. 56). Bruner's "implement" analogy labels media and its imagery as tools which do something to something else by enacting stimulation and causing a reaction or response from another human being. Each medium harbors its own characteristics, strengths, and weaknesses. Each is unique, Bruner explained.

Psychologist Johnson-Laird (1983) uses models to explain time, space, and motion. He also uses two other types of mental models. They include the meta-linguistic and the set-theoretic models. Essentially, linguistic expression and the use of mental tokens for connecting various elements and constructions summarize the "meta-linguistic" model. By abstracting semantic relationships of a language, the mind uses the symbolism and codes of a language to build one mental model within another, one language within another, thus the expression: meta-linguistic. Sets of numbers, expressed in mathematical form and mentally perceived, best describe the set-theoretic model.

Symbolic Theory, Signs and Symbols

Suzanne Langer (1957), humanistic philosopher of art and a leader in the fields of visualization and imagery, offers the following:

> But between the facts run the threads of unrecorded reality, momentarily recognized, wherever they come to the surface . . . the bright, twisted threads of symbolic envisagement, imagination, thought-memory and reconstructed memory, belief beyond experience, dream, make-believe, hypothesis, philosophy—the whole creative process of ideation, metaphor, and abstraction that makes human life an adventure in understanding (pp. 236-237).

Langer's (1957) symbolic theory of the mind breaks away from the boundaries of scientific deduction and inductive reasoning. She offers a world of metaphors, statements of meaning, signs and their abstract meaning, and symbolism. A-V-V-K imagery is closely associated with holistic, symbolic, and semiotic thinking. Her views parallel this author's symbolic-iconic theory of how imagery and motion media are perceived.

A universe of information and knowledge exists along a symbolic continuum, states William Winn, as "arbitrary symbols (e.g. words) at one end and realistic symbols (e.g., pictures) at the other end," (1982, p. 5). David Jonassen (1984) said that signs and icons serve "as a substitute for real experiences," and through iconic or other mediated events resemble the event or an object. He said signs and icons compress "reality to convey the ideas" and the meaning carried by those ideas (p. 161).

Signs and symbols serve two functions, stated educator Gavriel Salomon (1979), "as vehicles for communication and as vehicles for thought" (p. 116). Salomon called this an isomorphism, the mix "between communicational and mental coding elements" (p. 116).

Iconic Memory Units

In the concoction of perceptions, emotions, and thoughts, Iconic Memory Units are like an easily recalled thought or memory. Illustrative and illusionary, Iconic Memory Units provide signals for the mind, perceptually reducing an idea or an experience—in a phenomenological manner—to a level of "poignant essence." IMU's like thought-patterns and word-images are brought forward to a conscious level through recall. It is because of their iconicity and their repeated use that such experiences are remembered (Allan, 1991).

Conclusions

Imagery reproduced by motion media carry a multi-sensory amalgamation of mental experiences. The blending of these experiences phenomenologically intersect with the reality and perception of words, images, sounds, numerical data, and artistic expression. A-V-V-K imagery produces, in a recall mode, images that become symbolic and sign-bearing in nature.

Scientific and technological improvements in the development and production of motion media may well have exceeded our own capability to perceive, capture, and understand the imagery in our mind's eye.

Virtual reality, interactive computerized multi-media, and other evolving forms of media technology further stretches our mind's ability to perceive and interpret A-V-V-K imagery. The many literacies of A-V-V-K imagery, coupled with motion media's ability to serve, store, and disseminate information, may bring another challenge.

No doubt, our capacity for high-tech violence, excessively repetitive high speed chases, and the boredom of thin, shallow story lines in film and television has been exceeded. Good solid story line structure and better verbal imagery is needed. Aural and visual and kinesthetic imagery can oftentimes be overpowering. A balance is now needed: more in-depth characterizations and portrayals should be expected of the actors/actresses and producers/directors. The viewer-recipient should demand greater intellectual meaning in the content of motion media.

In the not too distant future, other forms of imagery will become popular. In addition to A-V-V-K imagery, the author suggests that the production, encapsulation, and distribution of other sensory forms—smell, touch, taste—and the imagery and perceptions they produce and convey will become common elements in the communication process. This will bring us closer to a more complete communication age, an age of total media and total imagery—an age of perceptually educated people. Some might even say that right-brained mental activity will become better understood and may even come into vogue.

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Perceptual Bases of Visual Literacy

by
Paul Messaris

Anyone with a scholarly interest in visual literacy is likely to have come across more than one story about people from pre-industrial societies who reportedly were unable to make any sense of their first encounters with photographs -- even when those photographs were of very familiar subjects (e.g., see Deregowski, 1980; Segall et al., 1966). Such accounts may be seen as evidence in favor of the proposition that the representational conventions of photographs and other kinds of pictures are largely or wholly arbitrary, despite the fact that viewers familiar with a particular pictorial style may think of it as being "natural" or "true to life." This view of pictures as an arbitrary system of signification was expressed as early as 1925 by the art historian Erwin Panofsky, in a celebrated essay on Renaissance perspective, but its most influential exponent has probably been the philosopher Nelson Goodman (1976).

Image-Reality Discrepancies

As Panofsky, Goodman, and other writers (e.g., Gombrich, 1960; Snyder, 1980; Wartofsky, 1984) have pointed out, many pictorial styles do indeed entail sharp discrepancies between image and reality. A minimal list of these discrepancies would encompass the following three broad areas:

(1) *Discrepancies in Color and Illumination*. For example, black-and-white photographs contain no information about the hue of colors, while unshaded outline drawings are uninformative about both color and illumination.

(2) *Discrepancies in Depth Cues*. Because pictures which attempt to represent three-dimensional scenes must do so on a flat, two-dimensional surface, all pictures lack some of the informational cues from which we infer the third dimension in real-world perception. (The nature of these cues will be described below.)

(3) *Discrepancies in Shape*. In many kinds of pictures, across a broad range of cultures and styles, the shapes of pictured objects are conventionally rendered very differently from the shapes of their real-world counterparts. Stick figures and most children's cartoons are good examples of this process.

In view of such discrepancies, it may seem intuitively reasonable to suppose that viewers who are not familiar with a particular pictorial style will be likely to have problems in interpreting pictures in that style. In other words, it may seem that we have here a good argument in support of the conclusion that pictorial conventions containing such discrepancies are indeed arbitrary, as Panofsky, Goodman, and their followers have claimed. As it happens, however, this conclusion has been contradicted repeatedly by a growing body of empirical evidence.

Over the past thirty years, more than a dozen studies have directly investigated how inexperienced viewers -- including children, people from societies without mass media, and even animal subjects -- respond to each of the three types of pictorial discrepancy listed above. Contrary to what one might have expected -- and contrary, also, to the outcomes of the anecdotal reports mentioned earlier -- these studies have found that inexperienced viewers are typically *not* troubled by the first and third types of discrepancy. In other words, they typically do *not* find it difficult to recognize the content of such things as black-and-white photographs, outline drawings, stick figures, and cartoons (provided the objects represented in these pictures are culturally familiar, of course). Only the perception of depth (i.e., the third dimension) in pictures is likely to be problematic for inexperienced viewers, although even this difficulty is by no means inevitable.

Explaining the Research

What could account for these findings? As Hagen (1980) has pointed out, investigators working in this area of research tend to be concerned with empirical details rather than with theoretical explication or synthesis. However, even before most of this research had been conducted, Gombrich (1960) had articulated a theoretical framework which turns out, in retrospect, to have been a promising way of approaching the research findings. The basic hypothesis explored by Gombrich was that, even if a picture does not look very much like the thing it is meant to represent, it may nonetheless provide to the eye and brain informational cues which are similar to those used in the perception of the real world. For example, perhaps the structural information contained in a stick figure (the relative length and position of the various body parts) is meaningful by itself to any perceiver (including someone who has never seen such a picture before). In other words, a crucial assumption underlying this approach is that of *modularity*: Perhaps our perceptual apparatus operates on the basis of discrete informational cues (about structure, about depth, etc.), so that, even if some of these cues are absent from a particular visual display (e.g., a picture), perception can proceed unimpeded with regard to the other parts of the display.

This view of picture perception is very different from the kind of approach exemplified by Goodman and his followers. It suggests that a broad range of pictorial conventions which may seem at first blush to be arbitrary are actually derivatives of real-world perceptual processes. It also suggests, therefore, that the continuity between skills of pictorial interpretation -- which may be seen as one of the building blocks of visual literacy -- and real-world perceptual processes may be much greater than someone like Goodman might imagine.

Although Gombrich's assumptions appeared to fit in well with a variety of observations in perceptual psychology as well as art history, he himself was initially quite tentative about these assumptions, because the state of scientific knowledge about visual perception was too inconclusive at the time to allow him to take a firm position. His subsequent encounter with the work of J.J. Gibson (1982) has dispelled much of this tentativeness (e.g., see Gombrich, 1984). However, for a fuller assessment of the adequacy of Gombrich's approach, we must turn to more recent developments in perceptual psychology. The past decade has seen major advances in the theory of vision, stemming most notably from the work of the late David Marr of M.I.T. (See Marr, 1982, for the most accessible account of Marr's basic theory.) These theoretical advances have resulted in a significant reconceptualization of the visual process, with direct implications for the issue which concerns us here, viz., the degree of continuity between real-world (unmediated) perception and the perception of pictures.

The Visual Process

The specific aspect of vision theory from which this connection emerges has to do with the brain's "translation" of the retinal image into a mental representation of identifiable objects in three-dimensional space. Marr's model of this process comprises three discrete steps. In the first step, the brain scans the visual information transmitted to it from the retina -- i.e., essentially a two-dimensional array of color and light values -- in search of discontinuities corresponding to the outlines of objects or the edges of surfaces. The end result of this stage of the visual process is a mental representation which Marr labels the "primal sketch" and which can be thought of as being equivalent to an outline drawing of the scene which the eyes are looking at. All further mental operations aimed at identifying the objects in the scene and inferring the scene's three-dimensional properties are conducted on the basis of this outline representation.

In other words, here we have an affirmation of Gombrich's assumption of modularity in visual processing: The ability to recognize objects and see three-dimensionally without reference to most details of light or color is actually built into our real-world visual apparatus. On the basis of this principle it seems reasonable to hypothesize that a pictorially inexperienced viewer should not in fact be hampered by the absence of color and/or shading in black-and-white photographs, outline drawings, etc., and, as already noted, systematic research -- as opposed to anecdotal evidence -- has supported this hypothesis (e.g., see Dusenbury, 1990; Hochberg and Brooks, 1962; Spain, 1983; Zimmerman and Hochberg, 1970).

Depth Perception

Step two in Marr's model of the visual process is concerned with computing depth -- i.e., the third dimension -- in the outline representation resulting from step one. This computation makes use of several types of information, or "depth cues," but for present purposes the following four are the most relevant ones:
(1) *Binocular Disparity*. Because the retinal image registered in the left eye is slightly different from that of the right eye (since the two eyes' points of view differ), and because the

magnitude of this difference in retinal images is inversely related to our distance from whatever it is we are looking at, the brain can use this difference in its computation of depth.

(2) *Motion Parallax*. Any change in the relative position of the viewer vis-a-vis the thing being viewed is accompanied by a change in the retinal image of that thing. Because the magnitude of the retinal change is also inversely related to distance (between viewer and thing viewed), it too can serve as a depth cue.

(3) *Texture Gradients*. Whenever we look at a scene containing a regular texture or pattern (e.g., a tiled floor, a picket fence, railroad ties, or even such naturally-occurring patterns as uniform-sized pebbles on a beach), the retinal image of that pattern will increase in density as distance increases. These variations in apparent density can serve as informational cues regarding the distance between the observer and the various parts of the scene she or he is looking at.

(4) *Occlusion*. When one object blocks our view of another object, we know that the former is closer to us than the latter. This is a trivially obvious, but nonetheless compelling, source of information about the three-dimensional properties of the scene we are looking at.

It should be readily apparent that the first two of these depth cues cannot possibly be incorporated into any ordinary, non-holographic still picture (although pairs of images viewed through 3-D glasses or other stereoscopic devices can of course mimic the effect of binocular disparity.) If our brain required the simultaneous operation of all four cues in order to compute depth, we would be forced to conclude that the perception of depth in still images must be an impossible task for pictorially inexperienced viewers. However, once again the principle of modularity comes into play here.

As Marr and others have noted (e.g., see Kubovy, 1986), there is good reason to believe that these depth cues can indeed operate independently of one another. Consequently, if a particular picture contains enough information about depth in the form of texture gradients and/or occlusion, inexperienced viewers should *not* find it difficult to see depth in that picture. A picture meeting these criteria has been tested in a study conducted in New Guinea by Cook (1981), and the results supported this assumption. On the other hand, of course, when texture gradients and occlusion are either entirely absent from a picture or are not sufficiently informative to generate an adequate sense of three-dimensional space, we should not be surprised to find that inexperienced viewers do not perceive depth in that picture. This assumption, too, has been confirmed experimentally (see Hudson, 1967; also Hagen and Johnson, 1977; Hamdi et al., 1982; Mshelia and Lapidus, 1990).

Object Identification

The third and final step in the visual process which concerns us here entails the identification of the various objects in the visual field. This part of the process is not yet understood as well as the previous two, but what is known about it does permit us to say that Gombrich appears to have been correct in speculating that structure alone -- without surface details -- might be a sufficient basis for object recognition.

As described by Marr, the brain's activity at this stage in the visual process consists of "reducing" the outlines of objects into a more elementary representational form in which only the basic underlying structure is retained, while many incidental details are discarded. (In other words, at this point the brain's processing of visual information goes beyond the outline format which was the result of step one.) These more basic structural representations are then matched against a "dictionary" of object structures in the brain's memory. Thus, two different outlines will lead to the same ultimate labelling of an object so long as their underlying structures match; and it is this feature of real-world vision which is assumed to account for our ability to recognize a particular object in any number of different circumstances (e.g., different points of view, different levels of illumination, etc.).

When it comes to specifically *pictorial* variations in the appearance of an object, then -- e.g., the transformations entailed in stick figures, cartoons, sketches, etc. -- Marr's theory suggests that a viewer's ability to interpret such pictures may be an extension of an everyday, real-world perceptual skill, rather than something one has to learn through previous experience with similar pictures. It follows, therefore, that inexperienced viewers should be able to recognize the objects in such pictures without much difficulty -- and, as noted earlier, this has indeed been found to be true in studies of this issue (Cook, 1981; Kennedy and Ross, 1975).

Implications

We have seen that a broad variety of pictorial styles which may seem, intuitively, to entail major departures from the appearance of the real world -- e.g., black-and-white photographs, outline drawings, stick figures, cartoons -- do not appear to pose significant interpretational obstacles to viewers unfamiliar with those styles. This observation, which has been confirmed by a growing body of empirical investigations, goes against the implications of certain oft-cited anecdotal accounts about first-time viewers' responses to photographs and other kinds of images. Does the argument developed in this paper imply that these anecdotal accounts were exaggerations or even fabrications? Not necessarily. As Deregowski et al. (1972) have shown in a detailed study of this issue, it is quite likely that the viewers' puzzlement reported in these accounts was due to lack of familiarity with the pictorial media -- typically, paper -- rather than being a response to the actual content of the pictures. This view has been supported by recent research in an isolated rural area in Kenya (R. Hobbs, personal communication, 1992).

What are the broader implications of the issues examined in this paper? It has been argued that the skills required for the interpretation of the conventions of pictorial representation may be, to a significant extent, derivatives of real-world perceptual processes, rather than arbitrary, picture-specific mental habits. To the extent that this is true, pictures may be thought of as being, in that regard, a more readily accessible mode of communication than language, whose semantic and syntactic codes are almost exclusively arbitrary. Does this greater accessibility of pictorial communication imply that the social need for visual literacy is less than the need for verbal skills? If anything, the contrary should be true. Precisely because of their greater accessibility to the untutored viewer, images as a mode of communication may be unmatched in their capacity for manipulation and misinformation (see Messaris, 1992; in press). The need for visual literacy in its broadest sense -- i.e., as reflective, critical awareness of visual conventions and their uses -- should be correspondingly acute.

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The Effect of Visual Mental Imagery on Speed and Accuracy of Information Retrieval

by

Carol L. Hodes

Instructional design is a field of study which focuses on the impact of instructional variables. The goal of this study was to compare two instructional variables and learn more about their influence on learning and cognitive strategies.

The instructional variables in this study (Hodes 1990, 1992) were visual illustrations and visual mental imagery. Visual illustrations are a heavily studied area and have been shown to help learners isolate and identify important material, recall prior knowledge, provide interaction with content, and enhance information acquisition (Dwyer et al., 1988; Winn et al., 1991).

On the other hand, visual mental imagery is a prominent cognitive process, however it is thought to be under used for learning and is not well researched as an instructional variable. Several studies that try to have subjects use mental imagery are documented (Anderson & Kulhavy, 1972; Kulhavy & Swenson, 1975; Gagne, 1985; Weinstein & Mayer, 1986).

The dual-code theory supports the use of imagery as an instructional variable. According to this theory, learning improves when mental images are formed during accretion because imaged material has two codes, both verbal and non-verbal, in memory. Also, dual-code research has shown that familiar, unambiguous visual illustrations summarize important information and maximize the availability of both verbal and non-verbal cognitive processes, thus promoting dual-coding (Paivio 1969, 1972). Therefore, attempts to combine visual illustrations and visual mental imagery would facilitate learning.

Method

In a completely randomized factorial design, the treatments consisted of four versions of a text-based 2000-word module on the structure and function of the human heart. This module had available three criterion-referenced multiple choice posttests which have been validated for specific types of learning (Dwyer, 1978).

A total of 112 undergraduates participated. To ensure that the subjects were novices in the content area of the study, students with extensive prior knowledge of heart function, i.e., pre-med or physiology majors, were excluded. Subjects were randomly assigned to groups.

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Independent Variables and Treatment Groups

The four treatment groups of 28 subjects each, dealt with instructional text about the human heart, with related visual illustrations and instructions to form visual mental images. The text-only group was group T; the text plus visual illustrations group was group TV; the text plus imagery instructions group was group TI; and the text plus both imagery instructional and visual illustrations was group TVI.

Visual Illustrations. The treatment booklets and related visuals were based on those used previously by Lamberski (1980). The visual illustrations were clear, unambiguous line drawings containing verbal labels on the structures, which is a type shown by Dwyer (1978) to facilitate learning in a cost-effective manner.
Imagery Instructions. Based on Kulhavy and Swenson (1975), imagery instructions were placed on each page of the treatment booklets for the instructed groups. The method described by Dwyer (1978) for the placement of visuals in text was followed in order to correctly derive the instructions to form visual mental images. The treatment without visuals (control) was given to 19 subjects as a pilot study. An item analysis (Gronlund, 1985) of their posttest results formed a guideline for the design of specific instructions to form images. Items with an item difficulty index of less than 60 percent were included in the formation of the instructions. The appropriate imagery instructions were then inserted on each page of the booklets for the imagery treatments. Shepard and Podgarny (1978) and Bransford et al. (1982) state that specific instructions help ensure better internalization and, thus, better posttest results. Also, placing the instructions on each page was rooted in the need to maintain imagery throughout the treatment. Such a technique was used with general imagery instructions by Kulhavy and Swenson (1975).

Dependent Variables

The three criterion-referenced multiple-choice posttests (recognition task) each containing 20 questions are terminology, identification, and comprehension. The terminology test measures knowledge of basic facts and definitions as presented in the text. The identification test is a recognition test that provides visual cues (a heart diagram with numbered arrows) for naming and discriminating heart structures. The comprehension test measures the subject's understanding of the heart's function and requires the subjects to generate concrete visual images in order to locate and position "parts of the heart in their mind's eye" and "mentally simulate functions and movements of the various parts of the heart"...(Dwyer, 1978, pp. 46-47) as this information is retrieved. The following average KR-20 reliability coefficients for each criterion test have been reported by Dwyer (1978): 0.83, terminology; 0.81, identification; 0.77 comprehension, and 0.92 total criterion test (p. 47).

The drawing test (the recall task) was a page with a list of twenty structures described in the text. Each structure had to be included on the drawing. A point was given for each correctly placed structure on the drawing. A Kuder-Richardson reliability coefficient of 0.839 was calculated for this test.

Drawing is related to the generation of mental images. Such a task requires the subjects to generate an image in the visual buffer of short term memory before they can correctly reproduce the anatomical structures and symbols with respect to each other. This is the visual-to-motor translation process described by Farah (1984) in her extension of Kosslyn's (1980) imagery model.

Imagery instructions may cause subjects to attend to details of structural information resulting in the formation of a more complete mental representation. If there is a more complete mental representation due to the orienting quality of the imagery instructions and the increased attention to structural details, it should be evident when a constructional task is used as a criterion measure, such as drawing a complex object as described in text. The quality of the drawings was not a factor in the scoring. The scoring was based on correct placement of the structures.

A measure of time was also recorded to the nearest second by the subjects for both accretion (the reading portion of the treatments) and the testing portion. Theoretically, those receiving the imagery instructions should require more time to complete the reading task if imagery was induced during accretion (Kosslyn et al., 1984). If imagery was used extensively during the post testing, the subjects should also require more time.

A post-treatment questionnaire was also used to assess the subjects' perceptions of their use of imagery during the experiment. This questionnaire used a Likert scale and comprised four items which addressed the subjects' use of imagery and other learning strategies. The first item, for example, asked the subjects if they "formed pictures in their mind" during the task they had just completed. The remainder of the questions collected a profile of the subjects' imagery, or mental "picture," use during formal learning and other situations, and asked the subjects to rate the accuracy of their images. A fifth item was a multiple-choice item which inquired about the subjects' dominant learning strategy during the treatment.

Results

ANOVA tests were used on all dependent measures. An alpha of 0.05 was used for all statistical tests. Using an alpha of 0.05, the critical value of F for 1 and 108 degrees of freedom is 3.92.

Achievement with Visuals versus Imagery

The ANOVA of the scores of the combined tests revealed a significant main effect for the visual illustration factor (F=5.32, p=0.02). When looking at the individual posttests, the visual illustrations also produced a significant main effect in the identification test (TV mean = 13.79, T mean = 12.54, F (visuals) = 12.05, p=0.001). The identification test is a type of visual test, since a diagram is used to identify parts when answering questions. Also, group TVI had the highest mean on the identification test (14.43), while the TI group's mean was the lowest (10.61), a pattern that was seen throughout the multiple-choice test scores. Thus, although specific imagery instructions might be effective for learning, they cannot replace the function of visual illustrations for learning and recognition tasks. In fact the group TVI mean on the identification test indicated that a moderate interaction (p. 0.08) had occurred between the visuals and the imagery instructions.

Drawing Test

Analysis of variance on the drawing posttest (recall task) revealed that group

TI's mean was significantly higher than the mean of group T, the control group ($F=4.79$, $df=1/108$, $p < 0.05$). The mean of group TV was also significantly higher than group T ($F=37.71$, $df=1/108$, $p < 0.00$). Therefore the more effective variable for a constructional task is visual illustrations. Samples of the drawing test from group TI (an "instructed" subjects) and group T (an "uninstructed" subject are shown in figures 1 and 2.

Significant positive correlations were also found between the drawing test scores and more accretion time ($r=0.267$, $p <0.01$), and the drawing test scores and the use of imagery during accretion ($r=0.253$, $p<0.05$). In addition, subjects with the highest multiple-choice test scores were more likely to use imagery heavily during accretion ($r=0.258$, $p<0.01$). Thus, the use of mental imagery may increase interactions with the instructional material which requires more time, as well as improve performance on both multiple-choice (recognition) and constructional tasks.

Patterns of Imagery Use

The five items that inquired about the use of imagery as a strategy were the basis for the correlations and observations about the subjects' perceived imagery use during the experimental task, for other learning tasks, and during other tasks. Subjects with higher task use of imagery required less time to complete the multiple-choice tests ($r=-0.228$, $p< 0.05$), and claimed to use imagery more heavily during other learning tasks ($r=0.473$, $p<0.01$).

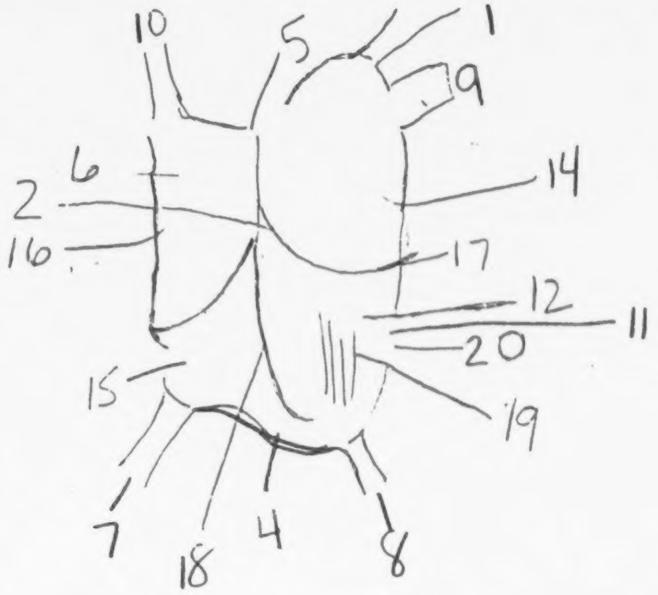
Subjects who felt that they formed accurate mental images were more likely to report higher task use of imagery ($r=0.404$, $p<0.01$) and were more likely to use imagery during other learning tasks ($r=0.429$, $p<0.01$).

Discussion and Conclusions

The results of the present study reinforce the importance of relevant visuals to learning as summarized by Dwyer (1978), Dwyer et al. (1988), and Winn (1989), and the prominence of imagery use during accretion and retrieval. The analysis of the multiple-choice (recognition) posttests showed that the main effects were largely produced by the presence of the visual illustrations. However, for the drawing (recall) test, it was the imagery factor that produced the significant results although it was not the dominant strategy used by this group (TI) during accretion. A moderate but nonsignificant interaction was also noted between the visuals and imagery on the identification test, which used a diagram to test recognition of structures and can be considered a visual test. The significant differences in accretion time indicate that, although imagery is widely and heavily used during accretion, more extensive use of imagery can be induced by including visual illustrations.

The results of the present study provide evidence that imagery instructions are valuable for increasing learner interactions with instructional materials, and they may be especially important when spatial information must be learned. Some have argued that imagery instructions simply increase interest or motivation (Paivio, 1969). However, it seems that imagery instructions may be important for accurate learning of spatial or structural information. When visuals are presented, the spatial information is analyzed and processed. In the encoding process, parts of

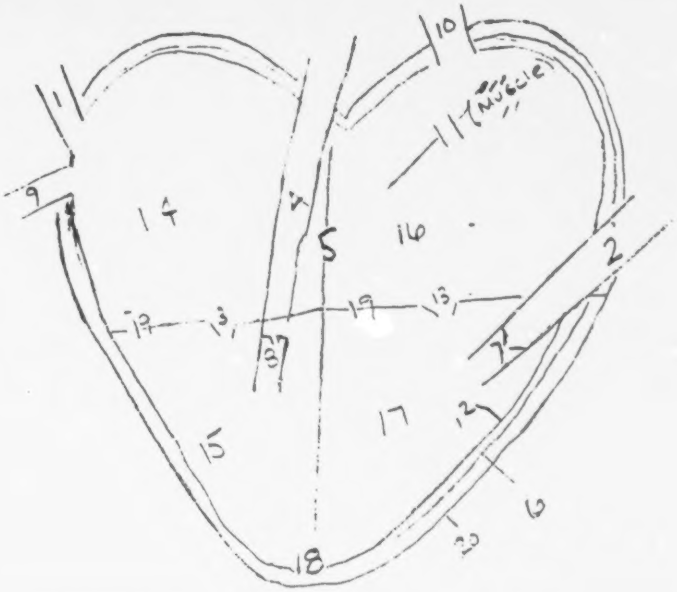
Directions: Draw a simple line picture of the heart and place the corresponding number (use the 20 parts in the list) where they would be located on the heart.



1. Superior Vena Cava
2. Aorta
3. Tricuspid Valve
4. Pulmonary Valve
5. Septum
6. Epicardium
7. Aortic Valve
8. Pulmonary Valve
9. Inferior Vena Cava
10. Pulmonary Artery
11. Myocardium
12. Endocardium
13. Mitral Valve
14. Right Auricle
15. Right Ventricle
16. Left Auricle
17. Left Auricle
18. Apex
19. Tendons
20. Pericardium

Figure 1. Drawing test of an uninstructed subject.

Directions: Draw a simple line picture of the heart and place the corresponding number (use the 20 parts in the list) where they would be located on the heart.



1. Superior Vena Cava
2. Aorta
3. Tricuspid Valve
4. Pulmonary Valve
5. Septum
6. Epicardium
7. Aortic Valve
8. Pulmonary Valve
9. Inferior Vena Cava
10. Pulmonary Artery
11. Myocardium
12. Endocardium
13. Mitral Valve
14. Right Auricle
15. Right Ventricle
16. Left Auricle
17. Left Auricle
18. Apex
19. Tendons
20. Pericardium

Figure 2. The drawing test of an instructed subject.

a visual illustration are given verbal labels and are concurrently analyzed by the nonverbal system regarding spatial and temporal relationships. Apparently, from the drawing scores of group TI, learners appear to benefit from using imagery.

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COMPUTERS
&
VISUAL LITERACY

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BEST COPY AVAILABLE

Moving from U.S. Mail to E-Mail

by
Laurie F. Ruberg and Mary G. Miller

Computer-based network communication is increasing at the rate of twenty-five percent per month--an increase which would put every single human being online within a few decades (Barlow, 1992). The dramatic increase in use of electronic mail represents a technological change with direct and indirect impact on all segments of our society. Well established electronic communities are easy to find in high-technology organizations, universities, and in the financial industry. In addition, successful networks are becoming more common in less likely places such as elementary schools, professional discussion groups, and even in restaurants (Sproull and Kiesler, 1991).

The increasing use of computer technology for sending and receiving electronic mail messages signifies changes not only in how we communicate but also signals changes in the skills, knowledge, and practices associated with communication by mail.

Since current electronic mail systems primarily consist of text-based messages, this medium relies heavily on visual (text) cues to facilitate effective information exchanges. This discussion looks at some of the characteristics of electronic communication and addresses some key questions regarding the move from U.S. mail to e-mail: What do we gain? What do we lose? And what do we need to consider to make the most effective use of this visual, text-based communication technology?

What is electronic mail?

Essentially electronic mail refers to the capacity to send and receive messages on a computer network. Electronic mail software uses computer text processing tools and computer network links to provide high-speed message processing and exchange services to persons who have "addresses" on a given computer network. E-mail differs from fixed-format numerical data in that mail software lets people use free-format natural language in their messages (Sproull and Kiesler, 1991). Early use of electronic mail services in the 1960's and 70's resulted from the development of packet-switched networking and communication protocols. This development of network technology made sending messages to remote computers possible and led to the development of computer-based communications.

The definition of electronic mail

adopted after many months of deliberation by the Electronic Mail Association (EMA) describes the technical aspects of this process: "Electronic mail is the generic name for non-interactive communication of text, data, image or voice messages between a sender and designated recipients by systems utilizing telecommunications links" (Caswell, 1988, p. 2).

People of all levels of technical experience and expertise have readily taken to electronic mail and use this technological resource to interact with others in many diverse ways. As a tool for communications electronic mail "fits into a continuum of communication media, including the telephone, physical mail delivery systems, and even broadcast media such as radio and television" (Caswell, 1988, p. 15). In addition to this list e-mail is an alternative to face-to-face interaction. As one campus computing center expert explains, "E-mail has found its own niche in communications; it hasn't taken the place of formal letter or documentation" (Sanders, W., personal communication, September 23, 1992).

Individuals may use one or more of the following types of electronic mail systems: (1)telex (TWX or Mailgram); (2)facsimile; (3)communicating word processors and teletex; (4)computer-based message systems; (5)personal computers; (6)voice mail systems; and (7)computer conferencing systems (Caswell, 1988). Each of these different systems has its own unique set of cost and benefit features. It is beyond the scope of this article to compare the technical aspects of these systems. Instead, we will focus more on the interpersonal and visual aspects of electronic communication and how it has an impact on the way people exchange information.

What do we gain by using electronic mail?

One of the benefits most often cited by e-mail enthusiasts is that use of electronic communication technology is tremendously faster than physical mail systems which usually require one to two hours for local deliveries and a minimum of 24 hours otherwise. In contrast, electronic messages can be sent and received within minutes regardless of the geographic distance.

Additional benefits of electronic mail derive from the ways in which use of this technology enables one to receive, process, and share information in a different way. The particular indirect benefits an individual experiences relate to the user's preferences and work habits. Some of the job-related benefits of using electronic mail typically cited by frequent users include:

- Reduces telephone tag since communication can be accomplished asynchronously;

- Improves productivity gains of PCs and other office automation systems;

- Improves communications, especially when time zone differences make telephone communications difficult or impossible;

- Facilitates greater interactivity with peers and staff in work environment since instant reply or reply with text of original message facilitate quick/immediate response to messages as they are read;

- Facilitates knowledge of peer activities through on-line professional conference groups and lists.

Some additional benefits to using electronic mail relate to the capabilities provided by the "electronic mailbox." Users of electronic mail systems are typically provided with some allocation of disc space either on their own personal system or on their local network typically referred to as one's mailbox or reader or electronic "in-box." The visual listing of mail shown in Table 1 shows how electronic mailboxes provide a manipulative organization to one's messages which facilitates a quick assessment of mail by date, author, or topic.

Size of in-box. All users don't have the same size in-box for receiving and sending mail. Preliminary research on ways professionals in the field of information systems found that those with smaller sized in-boxes tended to feel more in control of their mail (Mackay, 1989) because their system limited the amount of mail received.

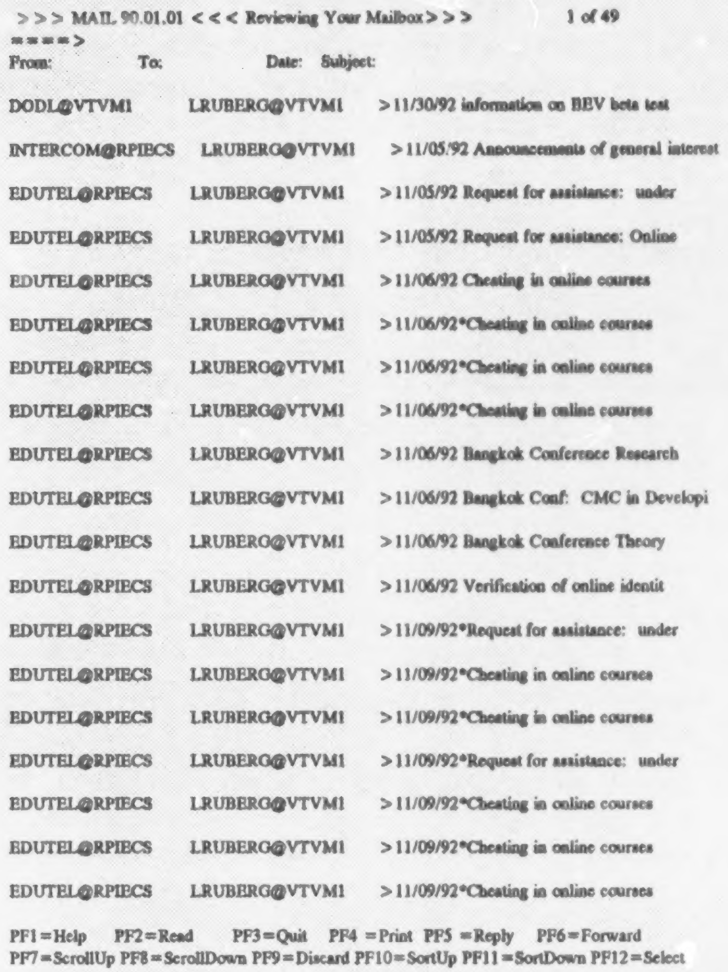
Functions available in mailbox. Twelve functions are available within the Mailbox of the Virginia Tech VM system: 1)Help - can provide on-line assistance with software interface; 2)Read - scrolls forward through mail items; 3)Quit - to exit the Mailbox; 4)Print - to print mail; 5)Reply to respond to a specific mail item; 6)Forward - to forward a mail message to another user; 7)ScrollUp - scrolls backward through mail list; 8) ScrollDown - scrolls forward through mail list; 9)Discard - erases a mail message; 10)SortUp - sorts mail from in ascending order by date received; 11)SortDown - sorts mail in descending order by date received; and 12)Select - identifies a mail item to be viewed. Table 1 shows these mail commands and a same listing of mail files.

Other mail systems will have different mail functions and a different user interface. The benefit to the user of electronic mail regardless of the specific mail functions available, is that the software interface provides an additional tool for processing mail before viewing it. For people who receive enormous amounts of mail such as 100 or more messages per day this ability to screen messages and make decisions about them is an extremely time saving facility (Mackay, 1989). This ability to screen and analyze mail through a mail reader or automated mail screener program may result in a person's ability to manage and process their communications with a few simple key strokes.

Unlike hard copy letters and documents, electronic messages are packets of digital information which the receiver has the ability to save or discard or reformat or change. Thus, the information receiver has ultimate control of the information and is able to manipulate the information to suit his/her own needs. Many e-mail users have developed efficient systems for categorizing and logging mail in designated electronic "folders" or "notebooks" as it is received. The ability to copy and forward messages via electronic mail has tremendous impact. A message one person receives from another individual or a group can be copied and sent to one or a thousand persons with a few simple key strokes.

Cost savings. Two economic trends are believed to have stimulated the

Table 1



```
>>> MAIL 90.01.01 <<< Reviewing Your Mailbox >>>            1 of 49
====>
From:            To:                  Date:   Subject:

DODL@VTVM1        LRUBERG@VTVM1     >11/30/92 information on BEV beta test

INTERCOM@RPIECS    LRUBERG@VTVM1     >11/05/92 Announcements of general interest

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/05/92 Request for assistance:  under

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/05/92 Request for assistance: Online

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/06/92 Cheating in online courses

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/06/92*Cheating in online courses

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/06/92*Cheating in online courses

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/06/92*Cheating in online courses

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/06/92 Bangkok Conference Research

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/06/92 Bangkok Conf:  CMC in Developi

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/06/92 Bangkok Conference Theory

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/06/92 Verification of online identit

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/09/92*Request for assistance:  under

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/09/92*Cheating in online courses

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/09/92*Cheating in online courses

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/09/92*Request for assistance:  under

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/09/92*Cheating in online courses

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/09/92*Cheating in online courses

EDUTEL@RPIECS     LRUBERG@VTVM1     >11/09/92*Cheating in online courses

PF1=Help    PF2=Read      PF3=Quit   PF4 =Print  PF5 =Reply    PF6=Forward
PF7=ScrollUp PF8=ScrollDown PF9=Discard PF10=SortUp PF11=SortDown PF12=Select
```

emergence and rapid expansion of computer-based communications: declining costs of computing systems and simultaneous decline in cost of long-distance telephone calls. Economic factors have continued to motivate an increasing number of professionals from such diverse fields as law, medicine, journalism, education, and business to use electronic mail. Costs associated with computing systems continue to decline and sending messages in electronic data format is considerably faster and cheaper than alternative day-time phone call or hard copy delivery systems. It is common for employees in business, industrial, governmental and university settings to have access to a locally designed electronic mail system.

What do we lose by using electronic mail?

The electronic mail sender loses control of physical appearance of information. Since e-mail occurs in a network environment and is primarily ASCI text with standard mail header, the look of electronic mail messages is significantly determined by the requirements of the communications system. Graphics, formatting, and stylistic embellishments we use to make printed documents more appealing are usually stripped from e-mail documents. In addition, the electronic mail loses the physical aspects/personalization of communications associated with hard copy format.

Part of the impact letters and documents have is based on the quality of the paper, print, and other graphic qualities on which the message is conveyed. Electronic mail is digital information exchange and thereby transient and changeable in nature. One exception to this rule is the electronic signature. Many individuals use their signature file as a way of personalizing their e-mail message and providing some distinct visual association with their communications.

Electronic mail is protected by the Communications Privacy Act passed by congress in 1986. Passage of this law makes it a crime to enter any electronic mail system illegally. E-mail records are also covered by the same wire-tapping and subpoena laws that govern other communication services such as the telephone. However, it has been documented in many instances on campus and within U.S. government systems that it is difficult to protect electronic information. The manager of the Virginia Tech computing center advises that e-mail should not be used for sensitive or private communications.

Costs of setting up system.

The process of acquiring, installing, and designing the format and procedures for a newly formed computer-based communication system can be expensive and time consuming. In order for new users of this technology to feel comfortable using a networked e-mail system the following design goals should be met for all individual users: (1)able to connect to the network easily; (2)able to retrieve their computer files easily; and (3)able to find their electronic mail easily. Training staff persons in how to use a new electronic mail system can be expensive and time consuming (Sproull and Kiesler, 1991).

What do we need to consider to make most effective use of this technology?

While electronic mail facilitates cost-effective and fast communications, there are some problems associated with this medium which need to be recognized and addressed as new systems evolve. Frequent users of electronic mail may begin to assume that everyone is comfortable communicating online. However, access to good network technology cannot always be assumed, and even when access is not a problem, attitudes towards computer technology may play a role as well. Not everyone is comfortable with this technology, and for some the costs or technical problems associated with their situation prohibit use of e-mail. Tombaugh (1984) found in his study of electronic communications among technical experts that participants in third world countries had significant difficulties establishing and using e-mail consistently and many of these problems were technical or equipment deficiencies which could not easily be resolved.

Connecting everyone early on with an individual work station and modem is preferable to connecting only a few through fiber optics that may take months or years to install (Sproull and Kiesler, 1991). Providing everyone with a connection for convenient access to network services gives all individuals the message that what they do counts more than what technology and a select few technology enthusiasts can do. Starting off with more simple systems which link everyone will make later upgrades to more sophisticated technologies (which usually require more technical skills) more easily accepted.

There are additional, indirect benefits of establishing computer-based communications systems which are simple and easy to use. Getting all employees connected early on provides valuable organizational experience. Electronic mail is a network technology which provides the means for people to communicate; however, it is the people using this technology who will define and redefine the nature of the online communication process. Thus, how the electronic communication process evolves depends on how individuals using the system apply the technology to meet their needs.

A large number of people using electronic mail on a regular basis do so because this service is provided through their work or via their institutional affiliation. However, starting from the very early use of e-mail described above individuals using electronic communication used this medium to send personal, informal messages as well as work-related information exchange (Sproull and Kiesler, 1991).

Diane Beals (1991) provides a summary of categories generally describing the intent of e-mail messages exchanged among a network linking first-year teachers. The teachers using this network rated how effective they felt e-mail was for different categories of tasks. These categories (describing the purpose for sending e-mail messages) are presented in ranked order from most to least common: (1)give moral and emotional support, (2)provide a broader perspective on educational issues, (3)keep in touch with friends, (4)reflect on philosophy of education, (5)exchange teaching techniques, (6)assist with classroom management issues, and (7)assist with lesson and curriculum. Thus, in this case teachers found e-mail to be a more effective tool for providing emotional support, philosophical discussion, and keeping in touch with friends than it was for assisting with lesson and curriculum planning.

Having all employees connected to a network communications system can have an impact on (1)the way employees work--independently and collectively; (2)the way employees think--people are exposed to a new resource for obtaining and exchanging information which stimulates new ideas; and (3)how people communicate. These changes are bound to stimulate changes in organizational structure and management. Inter-organizational integration of electronic communications systems can lead to increased interdependence between individuals who rely on mutually shared and constructed information from which mutually exclusive decisions are made. Increasing use of electronic communications also leads to greater dependence on computer resources which may eventually require some tradeoffs to be made between online partners which require online support and system load performance (Hart and Estrin, 1991).

At this time e-mail is primarily text messages viewed on the screen (or selectively printed and viewed). When considering the stratification of importance of messages by the medium of exchange electronic messages are still viewed as transient, less formal messages by many. Compared with a personalized letter sent on expensive paper with a highly stylized graphic logo and high quality printed message, an e-mail message carries little weight. With a single keystroke an electronic message may be erased and may seem to have never existed.

Conclusions

Using electronic mail has already been shown to provide increased speed, accuracy, and efficiency for information exchange. This technology also provides new ways of distributing messages not before imaginable. This can be seen in the enormous popularity of discussion lists which offer online interaction on nearly any topic imaginable. Among the greatest strengths electronic mail provides is the ability to transmit messages to one or many instantaneously regardless of geographic location, position, or situation of work.

Increased speed/access to communications leads to expectations for instant response which is not always desirable or possible. Based on this preliminary analysis of the differences between electronic mail and other traditional message systems, a few recommendations are offered to electronic mail users. Keep this and all applications of technology in perspective. Remember that communications technology is constantly evolving to change the needs of the people it serves. Be on the lookout for design changes needed and areas for renegotiating communications structures.

As direct access and direct communications resolve some communication problems other dilemmas emerge. Increasing bandwidth may reintroduce some social context cues the current technology lacks, but may not resolve all problems. Some users of electronic communications complain of suffering from information overload and being unable to manage all the e-mail they receive. There is no easy solution. At present, users must choose between a broad information access which many be inundating versus a narrow controlled access which limits one's perspective on information. Ultimately electronic mail users must remember who controls the switch to turn the technology on and off.

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Visual Cues for an Adaptive Expert System

by
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NCR Corporation, a subsidiary of AT&T, is pursuing opportunities to make their Point of Sale (POS) terminals easy to use and easy to learn. In a highly competitive retail supplier market, NCR recognizes the need to help their customers reduce the cost of operator training and avoid costly operator errors. The vision for the next generation of POS systems is to help make the terminal disappear, that is, to make the technology invisible to the user. Thus unencumbered from the mechanics of "computing," users can focus their energies at the task at hand: ringing up a sale at a POS.

To approach this vision, NCR developed an adaptive expert prototype system for a department store POS operation. An adaptive expert system uses technology that includes models of domain knowledge, operator knowledge, expert knowledge, and media presentation knowledge. These knowledge domains are employed in providing embedded training and intelligent, on-line help to the operator of the retail POS terminal.

The structure for the adaptive system called Retail User Assistant (RUA) was a software platform that performs the following activities in real-time:

Observe operator's activities and interactions with the terminal hardware and software while performing the tasks at hand.

Evaluate the operator's effectiveness in performing these activities against a model of "expert user" performance in the context of both the individual's and organizational rules and preferences.

Communicate with the user to provide guidance and task training as needed and as permitted by the working environment.

Adapt itself to compensate for changes in the user's level of knowledge and performance and to keep its communication with the user at an optimum.

In this project, NCR explored the use of text, graphics, and video to communicate to the POS operator. This paper discusses the development of the visual communication (user interface) for the adaptive expert prototype. First, the project process is explained. Second, the visual cue development decisions are discussed. Finally, the lessons learned from developing visual cues for a prototype system are presented.

PROJECT PROCESS

The prototype system consisted of an NCR 7052 POS terminal with a 2 X 20 operator display plus a 14 inch VGA monitor. The POS system ran the retail application software with the 2 X 20 display providing no more than 40 characters (alphanumeric) of feedback at any one time. The 14 inch VGA monitor displayed the adaptive expert messages to the user. These messages were retrieved from a videodisc. The adaptive expert application software monitored input from the retail application and then sent commands to the videodisc player indicating which segments to play. The messages displayed by the adaptive expert system combined text, graphics, and video to help the user perform the task.

To develop the visual cues for the adaptive expert system it was necessary to use a process that would drive the needs of the target users into the design and development of the prototype system. To accomplish this the designers followed a "User-Centered Design" process that greatly increases the chances of providing an effective and efficient communication channel with the user. User-Centered Design approach comes from a field called Human Factors Engineering, which combines analytical techniques with knowledge about humans and system design. It addresses the target users' perceptions of whether a system works well. A user asks, "Can I easily learn this system and then use it to perform my job efficiently?" These perceptions are the distinction between a functional communication system (2 X 20 display) as opposed to a usable communication system.

There are five phases in User-Centered Design process: Analysis, Concept Development, Prototype, Validation, and Implementation. These phases are briefly described below.

The *Analysis Phase* is essentially a data gathering phase. The developer collects information to gain an understanding of the targeted users and the nature of their work. The main objectives of this phase are to understand the user, task, and environment and the requirements of the POS system. The deliverables from this phase are task models, customer service models, system evaluations, and usability criteria.

The *Concept Development Phase* involves synthesizing the information collected in the analysis phase with the designer's knowledge of existing and emerging technology, human behavior, physiology, and psychology so as to develop solution strategies. The deliverables from this phase are concept documents, business models, and storyboards.

The *Prototype Phase* involves developing the completed storyboards into a working model. With a prototype the designer has a dynamic simulation of the system that can be used to gather informal user feedback. Iteration, a revision strategy, is extremely important in this phase, both for interaction style and instructional strategy. The deliverable from this phase is the "Look and Feel" of the proposed system.

The *Validation Phase* involves assessing whether the specified usability goals for the prototype have been achieved. The validation process involves following a formalized test plan using subjects who are typical users of the system. The deliverables from this phase is a design specification document and a revised prototype for the system developers.

The *Implementation Phase* involves using the design specification document and the revised prototype to bring the project to the product stage. Designers need to be integral part of the implementation team because many issues arise that are not addressed by the prototype specification document. The deliverable from this phase is the actual product.

There are two phases of the adaptive expert system that are discussed in this paper; the Analysis and the Concept Development. These two phases involved the conception and design for the prototype system. At the present time the Retail User Assistant project is in the final phase of prototyping and validation.

In the Analysis Phase, the objectives were to understand the user, task, and environment. The targeted users were department store sales associates. The designers first took the department store POS training course offered all new sales associates when they are hired. This step was important for several reasons. First, the designers learned the performance task and what tasks were difficult and easy to perform. The designers also became familiar with the instructional strategies used in the store training. Next, the designers observed the sales associates doing their jobs. Two methods were used. Cameras were set up and several days of videotape were shot for a detailed task analysis. Interviews of sales associates were conducted to gather demographic data, opinions of tasks' difficulty, and ideas on what information sales associates needed or wanted, but was not accessible on their present system. Also during observations, designers evaluated the work flow operation and the workstation design.

The in-depth analysis of the department store environment produced a user task model, the evaluation data on the current system, and the establishment of usability criteria. This phase took two months to complete. In product development, up-front analysis is extremely important. With this information, designers have a greater chance to design a product that will meet the needs of the user.

In the Concept Development Phase, the business model, visual display and instructional strategy were established. The business model stated the cost-justification of the expert system for a retail environment. The visual display and instructional strategy put an emphasis on the following:

- adapting information to the current needs of the user based on the terminal task and user request;
- utilizing various information delivery techniques including text, graphics and video.

One of the fundamental steps in designing an adaptive interface is determining what aspects of the system will change in response to changing conditions. In the Retail User Assistant, the primary method of adaptation was that of changing the information displayed. Another step in developing an adaptive interface is determining the condition that should cause the system to adapt. For example, the system might adapt to any of the following characteristics of the user, task, or environment:

- User experience with the task itself
- User previous experience (e.g., familiarity with GUI or command - line interface)
- User aptitudes (e.g., visual acuity or spatial reasoning ability)
- User preferences
- User demographic information
- Task complexity
- Task frequency
- Probable workload
- Physical conditions (e.g., adjusting the volume of audio messages according to the ambient noise level)

The RUA adapted to the user through recognizing the user's experience level, the task complexity, and task frequency. For each criterion used, there must be at least one source of data for the system. Data for the RUA was the user's experience level, an establishment of frequency/complexity ratings and the user's achievement on the system recorded in real time (Meyers, Yachemovic, and Harris, 1992).

Once the strategy for expert adaptation was established, the storyboards for the user interface were developed. Storyboards are meant to serve as an early visualization of display screens and the interaction style for the user. Creating a storyboard is valuable because the designer can easily examine several different approaches in determining the most effective solution strategy.

Storyboards are paper for a reason; they can be redesigned easily. No design, especially design that involves understanding and designing for the needs and requirements of humans, is done right the first time. Storyboards are the first representation of the interface, and are meant to be modified.

Storyboards for the RUA project were sketched out for several types of information displays. Due to the volume of screens that had to be developed for the project, a small group of storyboards was used to establish the overall look and interaction style. After, final revision of the storyboards, the actual screen displays were developed.

VISUAL CUE DEVELOPMENT

The RUA information displays were developed for three levels of adaptation. The first level was established as preventive and was considered the basic interface for the user. If the sales associate was not committing any process errors on the terminal and was not a new hire (less than a month), they were shown screens from the first level. The second level was established as corrective. The sales associate viewed these screens only when the expert system detected a process error. For example, when a sales associate tried to apply a discount that was not appropriate, a corrective message would be displayed. The corrective message provided information to the user on what error was committed and how to correct the error. After the error was corrected the screen display would return to the first level. The third level was established as comprehensive help. The sales associate viewed these screens when they requested additional help or the expert system detected repetitive errors by the user in a particular transaction set. For example, a sales associate constantly made mistakes when processing a layaway sale. The level three screens provided more in-depth information and often used video to explain a process.

In the design of the visual cues for these three levels several issues were addressed. These included:

- What is the best visual format for combining text, graphics, and video?
- How can icons, symbols, and colors be used effectively?
- How can two informational displays be used effectively by the operator?
- Will changing levels in screen displays be confusing to the user?

Previous experience in designing screens for POS applications helped to clarify some of the visual cue issues. For example, text was viewed as the least desirable method for delivering information (Lewis, Miller, Waller, 1991). Users tend to ignore the text directions when graphics or still images are present (Miller, 1991). To maximize the benefit of both text and graphics, they were combined together to formulate sentences. For example, a direction would be

"Scan item's "

The text emphasized the action while the graphic displayed what they were to scan. To decrease unnecessary text, all articles in sentences were eliminated.

Icons were used as screen titles. In this way, users could quickly identify the type of transaction started. For example, a screen with an open window icon meant the terminal was in the opening transaction, while a charge card icon meant that they were in a charge transaction.

Video was viewed as too time consuming for most transactions. Most customers would not want to wait while a sales associate viewed a 10 second video segment on how to complete a normal transaction. Therefore, video was used only when comprehensive help was needed. New associates often made mistakes inserting the various forms (charge, check) into the printer, therefore video was developed that showed how the forms were to be inserted.

Color was used effectively for text directions. Green text indicated a procedural step was appropriate. White text indicated only an explanation. In using green color for an appropriate or "GO" step, the designers took advantage of this color's accepted meaning in other real world areas.

Shape was also used as a visual cue. Solid arrows ▼ in front of text indicated both the beginning of a direction and an appropriate "GO" direction. This was in addition to the green color of the text. Solid blocks ■ in front of text meant these tasks were only appropriate if certain conditions existed.

From these few examples, it is easy to see that many rules existed for the visual cues. In this project there were over 200 screens created. To accelerate development and promote consistency, a set of visual cue rules were established. This proved very helpful as a communication tool among human factor designers and graphic designers. It also aided consistency in screen development that was accomplished in parallel. Rules established grammar, punctuation, font size and color, shape meaning and placement, icon size and placement, screen layout, and text and graphic placement. The rules were written and revised several times as the iterative design dictated.

LESSONS LEARNED

An emphasis in any good design should be on iteration. This project was no exception. The timing of iteration is crucial. For visual design of an interface, the storyboards should be taken to the users of the future system for their review. This was not done until after the storyboards had been turned into a functional prototype. Therefore, revision was more expensive.

The interaction and competition between the 2 X 20 display and the 14 inch display was an unknown before the usability testing. It was found that expert users often did not even notice the 14 inch display. Yet novices sometimes became confused when presented with different messages presented on the two screens. This area of two displays and how they can complement each other, instead of compete with each other, requires more analysis.

There was too much text on the screens. Users became confused because they were given so much information on what they could do, as opposed information on what was the most likely thing they wanted to do. For example, the most frequent task performed was a customer sale. Yet there was information on a refund, void, employee sale and layaway sale. This added confusion instead of clarification. Too much text on POS systems had been previously documented. (Miller, 1991). There also was too much information presented on the Level 1 preventive screens. At this level in the transaction set it was found that little assistance was required.

Color coding of the text proved to be a powerful delivery tool while the shape cue was lost to many of the users. The squares and blocks did not help users differentiate between types of directions.

In using icons, more user testing for recognition was needed. For example, an upside down shopping bag was not easily detected as a label for store returns.

In conclusion, establishing a rule methodology for screen design proved very effective. It forced design decisions early, it proved valuable for consistency on screen layout among human factor designers and graphic designers. The rule document for screen layout has proven valuable in other projects.

Color and graphics proved very appealing to the user. Yet using a combination of both color and shape to differentiate tasks proved confusing.

As for an adaptive expert system for retail operations, the verdict is still out. One reason is that the cost per system is prohibitive. Yet the idea of providing information to the user when and where it is needed is extremely appealing.

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Integrating Instructional, Graphical, and Message Design

by
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This project involved the development of a HyperCard application program entitled, *Connecting to Your MARS Account.* The purpose of the computer program was to assist users of the biomedical computer system at the University of Pittsburgh (MARS, ie., Medical ARchival System), to connect to their computer accounts through formats such as port entry or phone modem from Macintosh or PC computers. The program also aimed to facilitate uploading and downloading activities. Need for the program was identified from many requests for help in these areas by system users. A HyperCard based application program was selected for development because of its capacity to provide flexibility and ease of use as well as the rich mixing of text and images. In order to build a quality self instruction computer program, criteria from instructional, graphical and message design have been utilized. The criteria from instructional design included problem and task analysis; development of objectives, tests and strategies; building the prototype; evaluation and revision. The criteria from graphical design included composition in the areas of appeal, balance, innovation, information load, and inspiration. Graphical design also included attention to lettering in the areas of readability and spacing. The criteria from message design included attention to perception, memory, concept learning and attitude. These criteria were integrated increasingly as the project progressed. The criteria and distinct features associated with electronic text and images served as the basis for development of the evaluation research plan.

Background

For more than five years, electronic mail (email) has been available through the Medical ARchival System (MARS) at the University of Pittsburgh. Although email orientation classes have been provided regularly, as the number of users increased, the questions increased about various hardware and software combinations for connecting to the system. Sometimes users who had been to a class had new questions later when obtaining different hardware and software that could be used for electronic communication and transfer of files.To offer an option for users to learn in these areas, a computer tutorial was developed. Criteria from instructional, graphical and message design were used during the process. In the beginning, members of the development team used criteria tacitly as the criteria seemed to apply. However, explicitly identifying criteria soon became important as part of effective instructional product development. Since criteria are standards for making decisions, having explicit criteria helped to clarify the foundation from which the rest of the work could proceed consistently and rigouously.

Instructional Design

Overview of the Instructional Design Process

Instructional design is a plan for instruction that aims to bring about effective learning outcomes. To do this, the learners, what is to be learned and the conditions within the learning situation need to be assessed. Numerous scholars in fields such as education, psychology, and information science, have examined components of instructional design (Banathy, 1968; Briggs, 1970; Gagne, 1970; Henson & Knezek, 1991; Jonassen & Hannum, 1986; Seels & Glasgow, 1990; Tripp, 1991; Vockell, 1990).

Criteria. The following criteria reflect a synthesis of the above works. They evolved during the planning work of this project and are considered necessary inclusions for decision making when developing an instructional computer program.

1. Analysis of Problem - Analysis of the problem is ongoing throughout the design, development and testing of the program. Initial and ongoing analysis of problems is accomplished by the project team. Analysis means examining the parts of the project related to the whole of it. Problems mean questions requiring ideas and actions to answer the questions. The analysis has a purpose to observe features and functions of the parts and to note how the parts relate to each other merging toward a common goal: an effective computer program.

2. Analysis of Tasks - Activities of importance in a task analysis include to: a) analyze behavior to be taught; b) seek information sources to support the analysis; c) plan data collection instruments and procedures; e) review task analysis with project team members. An algorithm may be developed to provide a roadmap regarding the analysis of tasks. This roadmap could help project developers in making decisions in areas such as scope of learning or analytic method to be applied.

3. Development of Objectives, Instruments and Tests - In developing objectives and tests, the team includes these activities: a) determine complete objectives in cognitive, affective and psychomotor domains; b) determine the conditions and criteria for attainment of the objectives; c) determine the types of instruments and tests; d) construct, trial test and revise the instruments and tests. In the present project, the test planned required the learner to demonstrate an ability to use email and to transfer a file through MARS.

4. Development of Strategies for Self Instruction - These activities include: a) develop effective introductions to what is to be learned; b) present new material in a number of ways; c) link abstract to more concrete information; c) provide a choice of realistic practices; d) incorporate planning and problem solving elements; e) make provisions for motivational and corrective feedback. In addition to use of these strategies, provide an estimation to the learner about how long it should take to go through the program.

5. Selection of Instructional Media - During media selection the project team work through these actions: a) identify desired channel(s) for input of information; b) analyze the learning situation; c) analyze constraints and resources; d) determine type of media such as print, projected or interactive; e) determine if product already exists or needs to be developed. In this case the interactive feature was recognized as essential and since no product existed that would do the job that was wanted, development of the computer program was identified as necessary.

6. Development of Prototype - Use of a prototype method was considered important to arrive at a quality instructional computer program. Prototype software is a fully functioning piece of software with the desired features. Ongoing trial tests of the program are expected in an iterative

process and a number of versions are expected to emerge, each with improvements. A self instruction computer program prototype was viewed as including: a) title; b) directions for use; c) objectives; d) instructional sequencing or patterning with branching; e) arranged choices; f) examples; g) combination of graphics and text; h) summary. Additional aspects to be considered included a glossary, references and a posttest.

7. Use of Evaluation Research Methods - Knowing the effectiveness of an instructional computer program is not possible without testing its effects with learners. Therefore, a plan was devised to trial test the program with a variety of learners at different levels of background knowledge having to do with electronic communication and information systems. It was expected that a number of revisions would be made as test users worked with the program.

Summary. The criteria associated with instructional design have been increasingly implemented as this project has progressed. Their identification has created greater consistency among the project team in understanding the goals of the project and how to reach the goals. As the criteria involving instructional design have been worked with, it has become apparent that graphical design has also a major role in an instructional computer program.

Graphical Design

Overview of Graphical Design

Graphical design refers to the planned use of strategies to enhance visual communication through pictorial and text images. Greater unity of a basic idea can result from effective use of graphical design criteria. This capability to achieve visual unity can facilitate the viewer's understanding of the idea being conveyed.

Criteria. The graphical design criteria in this project included an emphasis on composition, readability and spacing. These criteria are described as follows:

1. Composition - The total picture impresses the viewer. The viewer scans in such a way that information needed to understand the meaning of the visual, is input conveniently. Within the composition the designer works to provide a) appeal; b) balance; c) innovation; d) optimal information load; and e) inspiration for the viewer. Appeal refers to those features that attract the attention of the viewer. If attention is not gained, learning will be impeded. Balance means that an esthetically pleasing effect has been achieved in the distribution of elements of the graphic. A balanced graphic offers stability. The learner begins to recognize patterns. These patterns serve as cues for the interactivity involved in using a computer program and also may assist retention of the content. The learner is assisted to focus on key content through a succession of visual cues (Dwyer, 1978).

While balance is helpful for stable effects, innovativeness is also incorporated to sharpen viewer alertness and interest. When the project staff can be freely creative during the early developmental period of product development, the result is likely to be more of an innovative product (Couch & Miller, 1990). This does not imply a lack of boundaries but it does mean that different forms of design strategies are encouraged.

In addition to appeal, balance and innovation, the information load needs to be considered. If too much information is on a screen at one time, the learner may become confused and not be able to interact. Finally, composition also includes attention to inspirational qualities offered on the screen. Inspirational qualities help to energize the learner.

Each of the compositional elements/qualities were designed into the present computer program. Examples include: a) Appeal was incorporated in the title screen. Spheres were depicted that helped guide attention much as a bullseye draws attention. b) Balance was used on the main screen that gave a menu for getting into the main content areas of the program c) Innovativeness in the present project could be seen in the screens that were designed with one ragged edge to indicate it was a portion of a bigger screen d) Information load was analyzed by all of the development team with the understanding that one basic and unified idea would be conveyed by each screen. The main menu screen was in three sections, equally balanced with information representing choices for interaction. The text was developed to be as succinct as possible so the viewer could scan each choice easily and quickly e) To inspire the learner, several learning objectives were listed at the beginning of the program. A summary of content was developed on one of the last screens as a reminder of what had preceded and as a way for the learner to check what had been learned The criterion of composition relates closely to two other graphical criteria of readability and spacing.

2. Readability - To make sense of the screens of a computer program, the screens need to be developed to be read easily. This means that new terms should stand out and perhaps be defined in a help section. Not only does text material offer readability, but so does the pictorial graphic. The icons or other non text symbols permit associations to enhance understanding of the content. Careful efforts need to be made so the pictorial graphics are not misread. This is where it is very helpful for the project team members to check with each other to validate the accuracy of interpreting the graphics. If doubt exists about their interpretation, then a panel of external experts should be consulted to provide interpretations. A discussion of their responses would help the developers decide on the actual graphics to be used.

3. Spacing - Spacing promotes readability because it makes possible the clear identification of each picture graphic or word of text. When a screen is overly crowded with not enough space around each graphic point, reading becomes difficult. Information may be misunderstood. When confronted by a series of cluttered screens, the learner may even give up in disgust. Trying to understand crowded or cluttered screens can be difficult, time consuming and wearing on the learner.

Summary. The complexity of information involved in instructing a person about electronic mail and up and downloading files requires that screens undergo careful composition with attention to readability and spacing. If the screens are not designed graphically to achieve perceptual coherence, that is unity, the elements are perceived as separately isolated entities (Osborne, 1986). This is different than intended for the learner. The learner would find it difficult to conceptualize and categorize as is done to establish accurate meanings. Today, increasing attention is being given to the capability of graphics to facilitate conceptual reasoning. For example, conceptual finding graphs have been developed to promote organization and storage of descriptive content into computer databases (Bernauer, 1992). Through conceptual finding graphs, categories of information may be communicated more clearly. Enabling communications in an instructional computer program also involves message design criteria.

Message Design

Overview of Message Design

Message design concerns a deliberate problem solving process involved in communication and the words and picture elements used to produce that communication. When the message is designed for instruction, the purpose is to influence or change the cognitive, affective or psychomotor behavior of individuals.

Criteria. The following criteria related to instructional message design include an emphasis on perception, memory, concept learning and attitude (Fleming & Levie, 1978; Mager, 1968).

1. Perception - When visual information is presented in an organized way, perception

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is enhanced. During perception, a person tends to group what is seen and tries to construct relationships between the parts identified in the view. For example, a figure in the foreground is differentiated from the background. Text on a computer screen is differentiated from the background of the screen. Recognizing that persons come from different experiences, and that perceptions can vary, computer program developers need to be very clear about any messages planned for the screen. Technical terms may not be fully understood, therefore a help glossary, descriptive succinct statements, and use of common terms may each help the learner correctly perceive the content of the program. An additional way the content of the HyperCard application program is organized to assist perception is by the numbers on successive screens to reflect location in a stack of cards. For example, card 1 of 4, card 2 of 7, and so forth.

2. Memory - When a person understands the meaning of messages presented, the information can be retained better. As messages or parts of messages are repeated, practice in thinking and remembering are facilitated. On a computer screen if the same prompt symbol is always shown when in the email mode, then the person has a number of opportunities to practice and remember that prompt symbol and to associate it with being in email.

3. Concept Learning - A concept is a mental image of a phenomen and can vary in abstractness. In terms of language use, a concept is thought of as an umbrella term under which similar items may be grouped. Critical attributes are used to more clearly define a concept. If one or more of the critical attributes is absent, then it is not the concept in its exact form (Walker & Avant, 1988). The use of examples helps to demonstrate the presence of a concept. As an illustration, in the computer program, in one screen the learner is presented information about baud rate. At the left of the screen 2400 baud rate is highlighted. In the text at the right is stated "2400 in this example."

4. Attitude - Although attitude is internal , consistent patterns of behavior are thought to give a clue about a person's attitude. A designed message holds the potential to influence or change attitude. This change has been associated with the perceived credibility and attractiveness of the source information. The developers of the computer program wanted to instill confidence in working with email and electronic transfer of files. It was reasoned that having a confident attitude toward performing these activities on the computer would promote use. Successful experiences on the computer during increased uses would provide positive feedback to the person, thereby increasing confidence again. The job for the developers was to put together an interesting program with positive experiences during interactivity with the program, thereby fostering the positive feedback cycle.

Summary. Message design criteria work hand in hand with instructional design criteria. Throughout instructional segments, the learner receives designed messages emphasizing an organization to the information in order to promote perception and memory, examples reflecting concepts, and positive yet correcting feedback cycles to influence attitude. Because these criteria incorporate pictures and text in the communications, graphical criteria are also naturally interwoven in the process.

Electronic Text and Images

Features

The electronic learning environment offers numerous opportunities for the learner to interact while using a program. This interaction comes under the control of the learner who can work rapidly or slowly, all at one time or in successive time periods, and exposed to a few branches or many (Jonassen, 1988). The project development staff working on the actual computer program tap into this electronic capability as instructional segments are prepared for the learner.

Controlled Access

Having control over the access of the content permits the learner to explore freely; to get into selected areas of interest and to avoid areas that are not desired. Time is a valuable commodity and having controlled access allows the learner to spend as much time as needed with the content at a time that is convenient. If the computer program can be used online, then the time factor would be further enhanced, especially for persons living a distance who gain access from remote sites. At the present time the project described here is accessed off line at individual microcomputers.

Interaction with Text and Pictorial Images

When a program has the rich mix of pictorial graphics and text, the learner has choices with which to interact. In addition, many of the choices can serve as visual cues to enhance recall for interactions at a later time. For a learner who has mostly used a receptive style of learning, when exposed to the high degree of interactivity that the computer program offers, may need time to become oriented to the interactive learning environment.

Diverse Structures

Structural components of a computer program begin with the initial plan for instruction and the decision points anticipated for the learner. Logic is incorporated into this plan. For example if the learner needs to have a technical term defined, then a sub-window can be made available for the learner to choose to see a definition. A multitude of interconnections are provided in the program so that a learner can move about the program easily from beginning to end, from main menu to several menus later and so forth.

Symbol Richness

A rich array of symbols is designed with purpose onto the screens of the computer program. Examples of symbols would be numbers, letters, glyphs or pictures and these symbols become representations of an occurrence or condition understood as the real world. To illustrate the program included a visual orientation to locate the user within the program; Card 1 of 5, Card 2 of 5, and so forth. The symbols are part of an overall learning environment that lead to rule making for data, awareness of information, and insight toward knowledge and wisdom (Debons, Horne & Cronenweth, 1988).

Use of HyperCard to Develop an Application Program

Overview of HyperCard

HyperCard, developed by Bill Atkinson, is an authoring tool that serves as a way to organize information (Goodman, 1987). It is used when an application program is wanted that needs organization and flexibility. HyperCard offers the ability to create stacks of information that can be retrieved as needed. It is also possible for the learner to move to other stacks by going to a central point in the program. HyperCard, operating in a Macintosh environment, has had many different types of application programs developed. A few examples of particular interest in the health fields include programs reported by Furman (1992), Rathe (1992), and Vinik, Sirman, Georges and Phillips (1992).

Description of Application Program Development

After an initial set of meetings of the developers of this project, the need was identified for the development of the HyperCard program to enhance email and file transfer knowledge of users of the MARS system. Over a period of a year the program was developed using the criteria discussed above. At several points, the program was tried out by the team to critically determine needs for revisions. In addition to checks by the project team, several trial tests with learners at varied levels of computer knowledge have been carried out. A documentation book has been developed to serve as a visual roadmap into the program. It consists of many of the actual screens that the learner would see in using the program.

Use of Evaluation Research Methods

Evaluation research is a next step associated with instructional design. The purpose of the evaluation component is to gain useful information about the effectiveness of the program to assist persons to learn in the targeted areas. Since the program should eventually be used alone by persons in a self learning mode, evaluations need to include observations of the use of the program as they occur naturally. Therefore, observations were made as individuals used the program for the first time. Three persons were observed individually. One person reported having beginning knowledge and skills on the computer and two persons reported having intermediate knowledge and skills. Two members of the project team made the observations and could independently conduct a content analysis of the field notes taken to be followed with a validation of themes through discussion.

The findings from the beginning trial tests of this program include these aspects: a) Learners may be puzzled or frustrated at certain points through the program, but they find it interesting and are motivated to continue because they want to use email and/or to transfer files. b) Besides content that will help learners understand the broader picture in using electronic systems, learners are interested in system specific information, that is, the information that will help them use their own computer configurations. c) After going through the program, the learners at both levels were better prepared to ask questions to further their ability to get on the system with their individual computer configurations. d) Each of the learners expressed the value of being able to use the program and the possible need to review it a later time. e) Transfer of files was of greater interest to learners who had more prior computer knowledge. In addition to these findings, the team also identified need for some sequencing changes in the screens and a few editorial revisions.

Summary

This project represents a combined effort among persons from different disciplines who pooled their knowledge in an attempt to solve an identified instructional problem. In working on the project the team recognized the importance of using criteria from work in instructional, graphical and message design. These bodies of knowledge when combined serve as a rich foundation from which to work creatively to develop a quality product. Evaluation research can help to reveal the effectiveness of their presence. The added features of an electronic environment such as controlled access and the abundance of interactivity suggest many possibilities for further research. This project will continue the evaluative observations of users in an attempt to gain greater understanding of the learning aspects of the program. This will help with decisions in planning other programs in the future.

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Image Databases

by
Rune Pettersson

This paper is a summary of an overview of different kinds of pictorial databases. In the overview, databases are discussed with respect to aims, user groups, search possibilities, storage, and distribution. Image databases are used for many different purposes. Examples are archives, catalogues, desktop publishing, educational material, general information, production of books and newspapers, research, specific information, and sales. The Swedish Council For Planning and Coordination of Research (FRN) funded the study.

Image database technology is undergoing fast development and is becoming widely used. Today, it's easy to store thousands of still photographs on optical discs. It is however often difficult to find them when they're needed. There are a host of different methods for indexing pictures and chances are that "the desired content" will not match a user's search criteria (Pettersson, 1989).

In 1991 FRN funded a project intended to describe general aspects of a variety of types of image databases. The project has involved reviewing informational material from a variety of sources, studying prototypes and systems shown at conferences and expositions. A summary of the findings discussed in the FRN. report follows (Pettersson, 1992).

Labor market for artists

The *Visual Artists Database, AXIS*, will be a source of information on currently active visual artists in Great Britain. It will serve as a line of communication between artists and users/buyers of art—government agencies, organizations, companies, and individuals. This increased exposure will probably create new job opportunities for artists—decorating public buildings, parks, etc. Also, it may help artists sell their finished works, or lead to other opportunities—lecturing in schools and libraries, for example.

Managing documents

Many companies have digital archive and document management systems. These systems can handle scanning, storage, and recovery of documents including text, pictures, diagrams, etc. Some systems, such as the *Grundig-GBA 2000 Electronic Archive System*, are suitable for the management of smaller archives. Others, such as *ImBase* and *Megadoc* are intended for larger archives.

Telling a story

Most systems present information in a very neutral and objective manner. It can just as well be presented in entertaining, stimulating, interesting, maybe even subjective formats. These formats can tell an intriguing story about the information. A project at Naturens Hus (The House of Nature) in Stockholm, documenting the Stockholm area's natural surroundings, is an example of this type of presentation, involveing not merely an image database but a full-scale multimedia system.

Preservation

The primary task of many archives and museums is the preservation and documentation of various types of objects. Image databases can do this, and will also make it easier to distribute such information outside museum walls. Museum information can thus reach a wider audience and be accessible for general use, study, and research.

Research

Some image databases are sources of specific information used in education and the transmission of knowledge. *TELIV* is a joint project run by UCIV, Universitetets Centrum för Interaktiv Video (The University Centre for Interactive Video), at the Malmö School of Dentistry and Lunds Datacentral för Forskning och Högre Utbildning (the Computer Centre for Research and Higher Education at the University of Lund). The goal of the project is to make pictures stored on electronic media available to researchers and educators in real time. It will be possible to access one or more video disc players from any terminal at the school of dentistry. A more ambitious UCIV project in the same vein is *Lunidia*. It will permit users of any computer connected to the Swedish university computing network, SUNET, to retrieve text and pictures from any database.

Spreading general information

Image databases can be used to spread broad, general information—encyclopedic information aimed at the public, providing introductions to a variety of topics. This use of image database technology could serve to improve the general level of education.

Caxton, a British publisher of reference works, was already experimenting with putting reference volumes and image databases on videotex in the late 1970's. Grolier, an American publisher, was marketing on-line and video disc versions of its reference works by the early 1980's, and CD-ROM versions (without pictures) by 1985. Grolier has for many years been preparing to release its works on CD-I, which handles pictures entirely differently from CD-ROM. An early Swedish publisher of reference volumes on CD-ROM was Esselte, which brought out its first CD-ROM encyclopedia in 1987. The target market includes libraries, the editorial departments of newspapers and magazines. One thousand pictures are stored on this CD-ROM.

Spreading topical information

The *British Film Institute* in London has a total of 6 million still photographs of actors and actresses, directors, etc.; 1 million newspaper clippings; and 400,000 films and television programs. They wish to make this material available to a variety of user groups: researchers, teachers, students, and the public. Information on films, TV programs, actors and actresses, directors, etc. has already been entered in a bibliographic text database, *SIFT* (Summary of Information on Film and Television). The pictures will be stored on optical discs.

The *BPI image bank*, developed at the Bibliotheque Publique d'information at the Centre Georges Pompidou in Paris, France, will contain 30,000 pictures. The pictures are organized using a standard library cataloguing method. They will be stored on a hard disk and distributed via ISDN, Integrated Services Digital Network, a broadband network for transmission of data, text, sound, and pictures.

Spreading specialized information

This area of use entails the spreading of detailed information to small target groups. *LaserNet* is an information and communication system offering information on art and antiques. The system stores the pictures and can be used to locate particular objects for interested customers, to access lists of auction prices, and to help prevent the purchase and sale of stolen goods. With accompanying text, they service subscribers via satellite. To use the database, a subscriber needs a satellite dish and a computer with a hard disk. Searches are based on text.

Poisonous Plants and Fungi, is a 200 picture database produced by The National Poisons Unit in London, UK. The pictures will be used by poison centers throughout Great Britain to identify plants poisonous to people. The pictures will be stored digitally on CD-ROM-XA. Searches will be made with the aid of an expert system. Pictures highlight characteristics used to distinguish between species, such as the shape and color of leaves and flowers, helping users decide, which pictures most resemble the plant in question. When the characteristics of the plant are defined, the system will display possible identifications and recommend treatment.

Document handling

Among the numerous systems for document handling, the more advanced electronic archive systems do much more than merely store information. One example is the *InfoImage Folder*. It can be adapted to meet a variety of user needs, such as offering the ability to attach electronic memos and reminders to individual documents.

Information on products and services

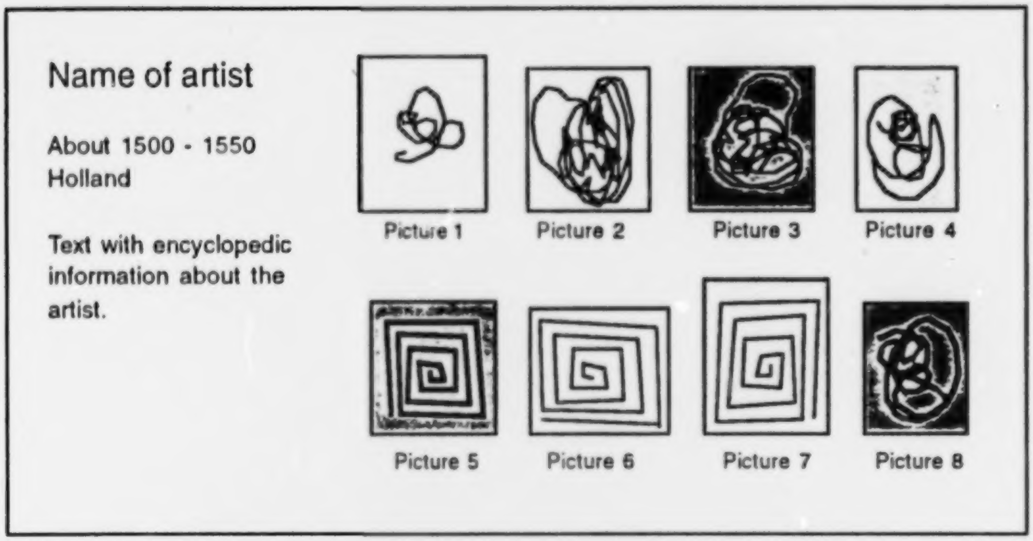
Find it is a "point of information" system, intended for the public. Terminals are placed, for example, in hotel lobbies. Information can be grouped in nine levels.

Info-video is also intended for use by the public. It can be used by retailers to present services and products, or by museums to supply visitors with information on exhibits.

Information on museums and exhibits

Museums have many informational needs. They must tell visitors about the current exhibit and provide information on the exhibits themselves.

Micro Gallery contains pictures of all 2200 works of art in the National Gallery in London, UK. The system constitutes a complete, illustrated electronic catalog. It is intended to make it easier for visitors to find information on individual works, and to find the works themselves. The museum is large and it is difficult to orient oneself there. Visitors can perform database search operations by pressing buttons



Name of artist

About 1500 - 1550
Holland

Text with encyclopedic information about the artist.

An example of information in a museum system. Mini pictures are in color. By "pressing buttons" more information may be accessed.

on the display. Information on a particular artist or painting can be accessed in several ways. There is a basic catalog and a historical atlas, both indexed by key words. There are also "lexicons" of picture types and artists. A successful search returns color "mini-pictures" and text. The text contains hypertext links, which allow the visitor to gradually access more detailed information. The system also lets visitors create personal maps, with the locations of the paintings of their choice.

Remote communication

New information technology is creating new remote communication opportunities. Architects can discuss architecture and interior decor with their clients; doctors can cooperate to make a diagnosis.

"Nuclear medical images" are frequently becoming common at some hospitals. The "digital x-ray department" will soon be a reality. Digital image processing offers tremendous advantages. Gray scale variation, for example, can be translated into more easily interpreted color differences. Traditional x-ray-film, can be digitized by a scanner, allowing them to be processed on a computer or distributed via modem over a dedicated telephone connection. Physicians at different hospitals can analyze the same x-ray simultaneously and discuss the diagnosis over the telephone. This is sometimes called *teleradiology*.

Personnel files

The *EDICON System* is a local *security system* consisting of personnel files with informational portraits of everyone at a given company. The system is used by companies where security is important, where employees must always wear clearly visible identification cards. The system has been used at seven airports in the UK, including Heathrow and Gatwick near London. The *Suspect Identification System* is a more advanced version of the EDICON System. It is used by the Yonkers police department, in New York, USA, to identify criminal suspects.

Presentations

Image databases can be used for a variety of types of presentation, and for producing presentation materials. Geographically related data can be presented easily and efficiently by the *MilPres II* information system. The system was designed for defense applications in Sweden, but has many civilian uses, too.

Producing documents

Image databases and libraries, such as Artline, Clip Art 3–D, Encapsulated Maple, Grafix, Image Club Artroom, Image Gallery, Mercury DTP, Photo Gallery, Spectrum Clip Art Disk, or Universal, make creating documents with decorative illustrations quick and easy. A graphics library may be a very good complement to a traditional graphics program. The primary target group for these products is users of desktop publishing software who produce such things as internal reports, memos and overhead transparencies for presentations. Electronic libraries are the modern counterpart of scrapbooks full of copyrighted pictures.

Producing educational materials

Image databases are sometimes designed expressly for use in the production of educational materials. Such products can also be used for other purposes. *InterFACE* (the Interactive Facial Animation Construction Environment) is used to produce animated talking heads. The source material includes 40 "actors," each with 16–120 pre-programmed facial expressions. They could also be used to produce language courses since the lips were synchronized with the sound.

Multimedia production

Photobase is an U.S. image collection including 2,000 photographs for use in multimedia applications, stored digitally using Intel's DVI format (Digital Video Interactive).

Print media production

Image databases and libraries like the *HDTV (High Definition Television) Still-Image File System*, *Imagebuilder*, and *K 2000 Picture Desk* allow quick, easy handling of pictures in the production of daily newspapers and magazines.

Television production

Gallery 2000 is an image database that simplifies the handling of graphic images used in television. It is particularly useful for news production. Images can either be created locally using a "paintbox system" or copied with a scanner and stored on digital optical discs.

Creating personalized products

"The Bicycle Company" is a special department of the *"Information Age"* exhibit at the National Museum of American History in Washington. It is a demonstration of personalized bicycle production, using a CAD/CAM system, *"Custom Design"*. By pointing at images of various parts the visitor may "build" his or her bicycle.

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Study

Some systems are designed to provide access to specialized information and to aid students. *MEDDIX DATA*, developed in Holland, includes 30,000 images. It is primarily intended for use by medical students, and includes information on many specialties. The database is a source of support material and data for students. Image databases may essentially eliminate the need for prepared microscopic slides that are used today.

Sales

Retail stores sometimes use "Point of Purchase" (POP) or "Point of Sales" (POS) displays interactive with computer terminals.

It will probably be possible to use similar systems to provide information on real estate (brokers and buyers), tourist destinations (travel agents and travelers), and signatures (security service companies and customers).

Sale of publication rights

Image databases will probably be used to keep track of and sell publication rights to photographs.

Bildbanken (The Image Bank) is a Swedish database intended to be a marketplace where photo agencies and photographers can meet the advertising agencies and publishers that buy their pictures. The system is designed to store up to 10 million pictures.

Image Bank, an American photo agency, has produced a video disc with 50,000 photos stored in analog format. The agency provides their customers, publishers and advertising agencies, with a source for interesting photo images.

Videotex information

Videotex, formerly known as videotext, is a two-way system for the transfer of information from databases to TV-sets with built-in decoders, or to specially adapted personal computers. Digital data signals are transmitted via the telephone network. A user calls the database from a terminal, and uses a remote control to browse through the database and find the desired information. In the future, it may even be possible to implement a voice-recognition-based user interface. Many countries have developed national systems. The first was viewdata (now Prestel) in the UK. Typical videotex users include real estate brokers and mail order companies. Videotex systems that permit good quality photo reproduction are sometimes called photo-videotex.

The FRN report also includes A discussion of systems for visual display, storage and distribution, and several search systems.

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Interdisciplinary Study with Computer-Based Multimedia

by

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The science educator has some new tools at his disposal. There is a unique opportunity to increase visual literacy in education as well as for curriculum reform. Yet more than newfangled equipment is necessary to accomplish better education. Aspects of visual literacy as well as Guilford's Structure of Intellect (SOI) model give us important considerations for instructional design which teaches facts and inspires students in compelling ways. Thus, a number of conceptual tools are presented for designing courseware for the interactive multimedia platform which is reviewed.

THE MULTIMEDIA REVOLUTION

Components

The multimedia revolution involves multiple industries, multiple technologies, and multiple modes of sensation. Telecommunications brings information from a distance to the learner on a television set or the desktop. Distance learning brings expert instruction via video and audio in real time. Also, telephone, digital voice mail, and computer BBS allow further methods for communication in any educational process. For example, the University of Phoenix offers an MBA which requires absolutely no on-campus activities.

At the heart of the multimedia revolution is the computer. Dramatic improvements in speed, capacity, compression, and price have allowed ordinary people to own machines with incredibly improved functional abilities relative to a short time ago. With more capable digital processing, temporal files are now possible, i.e. audio and video information of increasing fidelity can reside in computer memory. Finally, the laser printer and desktop publishing have revolutionized the cost and quality of print materials. From short memos to full manuscripts, publishing has become affordable at the grassroots level.

Gutenberg's Gamble

With all the exciting developments in multimedia one must remember to take an historical perspective on the application of educational technology. The revolution is of Gutenbergian proportions, but the risk for temporary failures is also as great as that experienced by Gutenberg himself (Gilardi, 1992).

A better jeweler and font engraver than marketeer, history's technological Columbus sailed into an economic morass. Because he misjudged the information-processing preferences of his market, Gutenberg actually saw his investment in the new printing lead him into dire financial bankruptcy. The Gutenberg Bible contained only one-tenth of the official manuscript available from the church. He published on parchment, requiring the slaughter of 40 sheep per book rather than on the new pulped rags material. Thus his books were approximately $25,000 per copy rather than one or two thousand dollars for the monks' handwritten works. Furthermore, he did not include the usual level of fine artistic embellishment:

> The protopublisher's third mistake: his 'automatic bible' contained no illustration--not even decorative initial letters which were left unembellished or even blank. Without 'illumination' a quality book was considered incomplete; therefore, in order to achieve the final product, the client incurred a considerable extra expense.
> (Gilardi, 1992, p. 7)

Contemporary multimedia publishers face a similar tradeoff. They must balance cost of development against expectation of customer. The high standard of commercial television is demanded by the eye, yet the affordability of a book is required by the pocketbook. Falling short of these benchmarks in the educational marketplace can mean a shortlived product.

Persistent Trends

Despite these challenges, interest remains strong for multimedia courseware. In the business world a recent study by Answers Research found that the use of multimedia involves 36% for use in training, 45% for off-site presentations, and 61% for on-site presentations (Borzo, 1992). Government analysts estimate the use of multimedia to grow from $900 million in 1992 to $2.4 billion in 1995 (Zurier and Liebowitz, 1992). The research record of interactive multimedia in training is a good one. A recent study by Fletcher (1990) reported a metaanalysis of studies in the military, industrial and educational spheres. This review found the educational technology to be effective and cost-effective. Still holding true is the 30, 30, 30 finding: one-third more learning, one-third less time, one-third less cost. O'Connor (1992) reported that a recent LINK study predicted that multimedia revenues from business, consumer, and education will grow from $777 million in 1991 to $13 billion by 1996.

In education the predicted growth in multimedia hardware and software is clear. The 1991-92 Market Study Report by Software Publishers Association (1992) discovered that sales for videodisc and CD-ROM are both predicted to have strong growth in the near-term. By 1991 there were 94,400 CD-ROM's installed in the schools. Another 64,600 CD-ROM's will be purchased by the end of the 91-92 school year. The number of videodisc players installed and planned for FY 91/92 are 110,600 and 60,900, respectively. Thirdly, integrated learning systems account for another major portion of expenditure on multimedia. It was estimated that 10% of all schools have ILS. The average number of stations at a school is 22.6 at a cost of $18,200 per station.

In FY 90/91 the schools spent a total of 598 million dollars on personal computer software. Two-thirds of purchases in the secondary schools and 87% of elementary were for instructional software. It was also interesting to note that in the software buying decisions in this survey, the most important factors related clearly to visual literacy and one of the key aspects of Guilford's Structure of Intellect model (SPA, 1992). They included:

1. Software that is easy to use;
2. Software that has a graphical user interface; and,
3. Software that builds problem solving skills.

MULTIMEDIA IN SCIENCE EDUCATION

Explosion in the Lab

Science education is the area of the most dramatic and intense work with educational technology. As Eiser (1992) points out, in the last 18 months more than a dozen major interactive videodisc packages for science instruction have been produced and marketed. The need for scientific literacy and the great improvements in speed, capacity and resolution of visual archives have combined to make an explosion of curriculum development.

Interactive multimedia is ideal for science instruction. Simulation of dangerous or expensive lab experiments can be observed over and over again without risk to limb or budget. Exploratory games involving academic concepts and facts facilitate scientific literacy. There is opportunity to ensure ability to solve problems as well as memorize facts. Dynamic and micoroscopic events can be blown up for all to see and stepped through in slow motion. With color, motion, stills, and the access power of a computer, multimedia is apt to be a helpful tool for any science teacher.

A Science Project

In the summer of 1990 the Santa Fe Christian School received a $50,000 grant from the Ahmanson Foundation to implement an interactive multimedia workstation for instruction in Middle School Earth and Life science (Couch and Peterson, 1991). The teacher, while expert in the content and pedagogy of her field, had never used a computer in her professional or personal life. Thus, she was an ideal test case for the "teacher-friendliness" critierion of good educational technology.

The courseware employed was videodisc packages from Optical Data Corporation and Videodiscovery. Content from these products was used in a generic sense, with the teacher adding distinctive material from her experience and Christian philosophical perspective. The supplementation was facilitated by an intuitive GUI-type "Presenter Stack" designed by Matt Evans in the MMCDL. The material was developed and presented on a large-screen television with a laser videodisc player and a Macintosh IIci computer.

Any instructional design will fall somewhere on a rationalist-romanticist spectrum. That is, some teaching will tend to focus on the facts of the discipline and other teaching will focus on the feelings of the student. Our goal is to remember both the objective and subjective aspects of education. Indeed, a Christian epistemology provides a foundation for considering the objective nature of the world as well as the heart. Working with the multimedia courseware, the teacher found that she became increasingly metaphorical and illustrative in her teaching. Whereas before she had to be very careful to not teach "over their heads", the convenient visuals allowed communication to be easier and richer. At the same time the rationalist component was strengthened because she used the computer to prepare expository outlines for the students. Based on observation, interviews and questionnaires, the students and teacher's experience with a rich reservoir of visual images and sequences gave them an enhanced scientific literacy and motivation for further study.

VISUAL LITERACY

Constructivist Definitions

In addition to scientific literacy, an overall increase in visual literacy occurred. Sinatra defines visual literacy as "the active reconstruction of past visual experience with incoming visual messages to obtain meaning." (p. 5, 1986).

In Kuhn's discussion of scientific paradigms, he emphasizes that a discipline is more than its facts and explicit theories. Paradigms are also images of scientists executing their methodologies as well as the visual metaphors that guide theoretical thinking. The famous "thought experiments", such as Einstein's man riding on a train through space and models such as the picture of DNA developed by Watson and Crick are based in the visual dimension. While the verbal and symbolic languages are used in science, it is often the visual language that stimulates discovery and helps communication of the scientific facts.

The "Who" of Visual Literacy

As the instructional designer prepares courseware with a visual emphasis, it is best done with principles consistent with the constructivist definition given above. A constructivist view of the multimedia learner and his sociological position is found in Omar K. Moore's Clarifying Environments Program (1969, 1980, 1992).

Moore's theory for instructional design is synaesthetic and is particulary helpful for those who want to promote visual literacy in education. He proposes four principles for understanding the learner as he works with instructional visual material:

1. Perspectives (Is the learner in the role of an agent, a patient, a reciprocator, and/or a referee?)
2. Productivity (Is the learner able to use the material in a heuristic way in future situations?)
3. Personalization (Is the learner working in a self-paced, exploratory, discovery-oriented, interconnected way with immediate feedback?)
4. Autotelicity (Is the learner working voluntarily?)

The "How" of Visually Literacy

The cognitive science of computer interface has been nicely articulated by Donald Norman of U.C. San Diego in his book *The Psychology of Everyday Things.* (1988) Considering the appearance of various machines, especially electronics, Norman has given theoretical and practical analysis of the intuitive nature of how things work. He describes the ergonomic feedback loop in terms of two basic phases: Execution and Evaluation. Applied visual literacy can be conceptualized in a similar way: an active reconstruction which involves executing and evaluating actions with visual material.

Norman presents an "approximate model" of how people interact with the visual cues of a computer interface. Seven imprecise stages are as follows:

- Forming the goal
- Forming the intention
- Specifying an action
- Executing the action
- Perceiving the state of the world
- Interpreting the state of the world
- Evaluating the outcome

Verbum Interactive 1.0

Prototypical examples of reconstructive multimedia science education can be found in *Verbum Interactive, 1.0*, the first CD-ROM multimedia magazine in which work from the SFEF MMCDL appears. In both the Zoo Adventure and Space Directory with Michael Carrol, the user is making choices and gathering information in a rich verbo-visual environment.

In their *Windows on Science* manual (1991), the signs of visual literacy are listed as follows:

1. Grasp composition of images
2. Decode meaning of images
3. Infer from image
4. Disregard emotional interference during critical analysis
5. Manipulate image mentally
6. Translate visual data into verbal insight
7. Incorporate new visual information into existing core of knowledge
8. Communicate through showing, arranging and composing visual images

As these activities are done, the who and how guidelines can be used for design and evaluation of multimedia products.

STRUCTURE OF INTELLECT

The "what" of Visual Literacy

In the late 1940's a research psychologist named J. P. Guilford developed a factorial approach to the structure of intellectual abilities. Throughout his research he stipulated a three dimensional cube of intellectual abilities which can be assessed and trained (Guilford, 1966). In addition to the Semantic and Symbolic dimensions the third main component of this schema is a dimension known as the Figural which primarily includes the visual abilities.

Like the Semantic and the Symbolic, the Figural content can be approached in various ways, at varying levels of complexity. Operations include Cognition, Memory, Evaluation, Problem Solving, and Creativity. These abilities are employed with material that ranges across Units, Classes, Relations, Systems, Transformations, and Implications.

A Research Center

In the 1992-93 academic year Santa Fe Educational Foundation and Key Technologies International plan to develop a Research Center on the campus of Santa Fe Christian School. Students will participate in SOI assessment of their abilities to work in various styles. Testing and training for weak areas will be delivered via computer through Online SOI and SmartMods. Teachers will alter their teaching and use of media as they learn about the individual students and reflect on the SOI three-dimensional grid of pedagogical considerations.

Multimedia affords the clear opportunity to build visual and scientific literacy through instructional design that takes into account the who, how and what of a student's visual experience in science education. As teachers and students become more adept in the visual realm, they may be able to balance the rationalist and the romantic poles of curriculum development.

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The Use of Images in Intelligent Advisor Systems

by

Marie-Michèle Boulet

Introduction

Among the mandatory courses of the undergraduate curriculum in Computer Science at Université Laval, there is *Systems analysis and design*. Information modeling, and more specifically Entity-Relationship approach (Chen, 1976), is an important topic covered in that course.

The production of an Entity-Relationship diagram (ERD) that actually represents the access paths to data needed by an enterprise, is a very complex transfer task. As stated by Leshin, Pollock, and Reigeluth (1992): "Transfer tasks have great variation from one performance to another" (p.49); "... cannot easily be broken down into steps, because the activity varies each time the task is performed" (p.82). They also add: "Complexity is determined by the number of new principles or guidelines required to generate the desired performance" (p. 92).

The *Systems analysis and design* course has two parts. Concepts, principles, and rules, are taught during a theoretical part. Learners transfer this knowledge during a practical part; they have to resolve cases. The COnceptual DAtabase Modeling Advisor (CODAMA) was developed to further the transfer of knowledge during the practical part.

Advisor system

An intelligent advisor system is an adaptive system aimed at intervening when an individual is performing a complex transfer task (Boulet, 1992). This instructional technology takes place after the initial learning of concepts, principles, and rules. It is an environment of help utterly linked to the use of what has been learned. Users think and integrate several kinds of knowledge to find the "right" way to solve a complex problem.

An important aspect to take into account is the identification of strategies and tactics the advisor uses to provide advice, guidance, hints, explanations, and to answer questions. The main purpose is to provide an environment tailored to the user's needs and goals. An advisor system helps either to relate theory to practice, or to develop more effective problem-solving strategies, or both.

CODAMA

Students enrolled in *Systems design and analysis* course have weak knowledge of the domain and no practical experience. They draw their ERD with a CASE tool (Computer Aided Software Engineering, Figure 1). CODAMA is interfaced to that CASE tool.

Figure 1 presents the CASE tool window. The set up of CODAMA adds an option within the menu bar: the ADVISOR option. A learner produced a part of an ERD. She or he created the entities COURSE, PROGRAM, ADDRESS, STUDENT, and PROFESSOR, and the relationships ENROLLS, GIVES, and HAS. There are properties not yet associated. Some cardinalities was set. The learner can call CODAMA to make sure that this part of the ERD actually represents the reality of the organization.

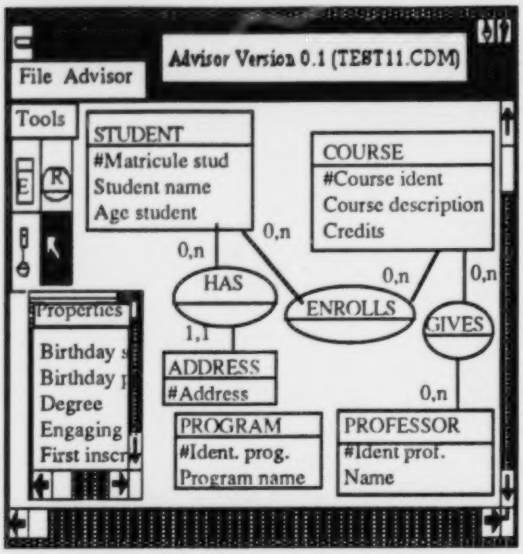

Advisor Version 0.1 (TEST11.CDM)
File Advisor
Tools
E
R
STUDENT
#Matricule stud
Student name
Age student
COURSE
#Course ident
Course description
Credits
0,n
0,n
HAS
0,n
0,n
ENROLLS
GIVES
1,1
Properties
Birthday s
Birthday p
Degree
Engaging
First inscr
ADDRESS
#Address
0,n
PROGRAM
#Ident. prog.
Program name
PROFESSOR
#Ident prof.
Name

Figure 1. CASE tool window.

Figure 2 shows the menu displayed after a learner told CODAMA that she or he wanted explanations about cardinalities of the relation ENROLLS.

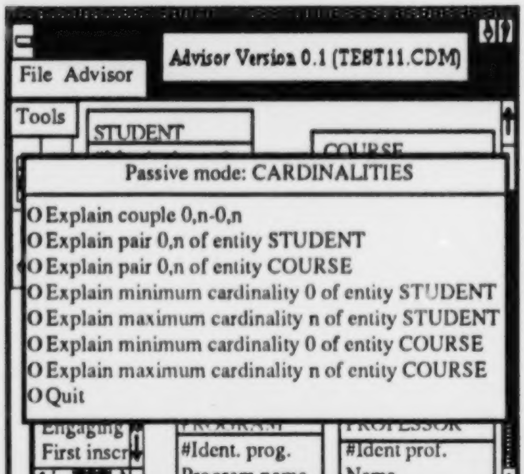
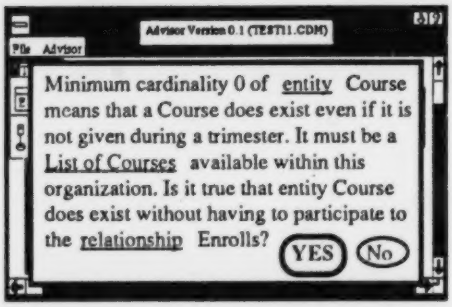

Advisor Version 0.1 (TEST11.CDM)
File Advisor
Tools
STUDENT
COURSE
Passive mode: CARDINALITIES
○ Explain couple 0,n-0,n
○ Explain pair 0,n of entity STUDENT
○ Explain pair 0,n of entity COURSE
○ Explain minimum cardinality 0 of entity STUDENT
○ Explain maximum cardinality n of entity STUDENT
○ Explain minimum cardinality 0 of entity COURSE
○ Explain maximum cardinality n of entity COURSE
○ Quit
Engaging
First inscr
PROGRAM
#Ident. prog.
Program name
PROFESSOR
#Ident prof.
Name

Figure 2. Example of menu.

Suppose that the learner selects *Explain minimum cardinality 0 of the entity STUDENT*. The explanation presented at Figure 3 will be superimposed. There are underlined words. Two of them refer to prerequisites: *Entity* and *relationship*. That means an individual cannot understand what is the meaning of this explanation if she or he does not know or does not remember what is an entity or a relationship. By clicking on one of those underlined words, the learner can have the corresponding explanation (or a set of explanations because there are other underlined words within other explanations). This access to prerequisites was set to help recalling one or another concept in the short term memory.


Advisor Version 0.1 (TEST11.CDM)
File Advisor

Minimum cardinality 0 of entity Course means that a Course does exist even if it is not given during a trimester. It must be a List of Courses available within this organization. Is it true that entity Course does exist without having to participate to the relationship Enrolls?

YES
No

Figure 3. CODAMA's answer.

The learner can also see and use a network. A part of the network is presented at Figure 4.

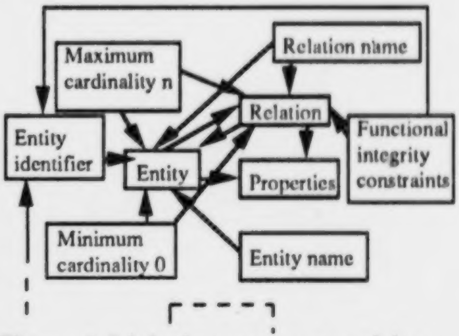

Maximum cardinality n
Relation name
Relation
Functional integrity constraints
Entity identifier
Entity
Properties
Minimum cardinality 0
Entity name

Figure 4. Links between prerequisites.

A network can be used in many ways. A learner can ask for the network showing prerequisites for a given concept. She or he can use it to have a given explanation by clicking on one or another box. Another learner can ask which box corresponds to a certain question she or he asked CODAMA. She or he can also see which box corresponds to a particular mistake that the advisor detected. Doing so, she or he will also see what are the related prerequisites.

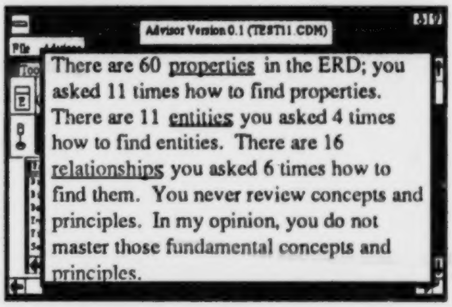
The third underlined group of words, i.e., *List of Courses* (Figure 3), refers to a hypothesis that CODAMA makes. If the student clicks on those words, CODAMA will present a list that is supposed to exist within the organization. Note that, for some other cases, CODAMA will present hypothetical forms such as a bill. This allows the student to relate her or his perception of the reality to the entity-relationship formalism. That is what an analyst MUST do during all her or his professional life, i.e., verify repeatedly whether what he or she models is the real thing.

An advance organizer (Ausubel, 1960) may be used before starting the process of elaborating an ERD. First, CODAMA displays a complete and real ERD obtained from experts. A knowledge acquisition module allows the collecting of those real ERDs. It is described in the next section of this paper. The ERD being displayed, the organizer simulates the elaboration of this ERD. The simulation is made in accordance with a hierarchy of prerequisites

When the advance organizer module intervenes after a user begins to elaborate an ERD, it takes into account the user's cognitive structure. There is a continuous collection of data that is invisible to the learner: questions asked and errors made are categorized and recorded.

Suppose that a learner used several menus but did not use keywords. CODAMA will fit its interventions. It could produce the advice presented at Figure 5.

Following this advice, CODAMA begins the simulation of the elaboration of an ERD. It will first refer to the highest element of the hierarchy consulted. That corresponds to where the learner is or wants to be. CODAMA will after go down the hierarchy to determine the content of its next explanations. In other words, it will present the prerequisites. When the bottom of the hierarchy is reached, CODAMA will go back all the hierarchy. In the particular case illustrated at Figure 5, CODAMA's simulation will put emphasis more on explanations related to fundamental concepts and principles than on the modeling technique.



There are 60 properties in the ERD; you asked 11 times how to find properties. There are 11 entities you asked 4 times how to find entities. There are 16 relationships you asked 6 times how to find them. You never review concepts and principles. In my opinion, you do not master those fundamental concepts and principles.

Figure 5 Example of advice.

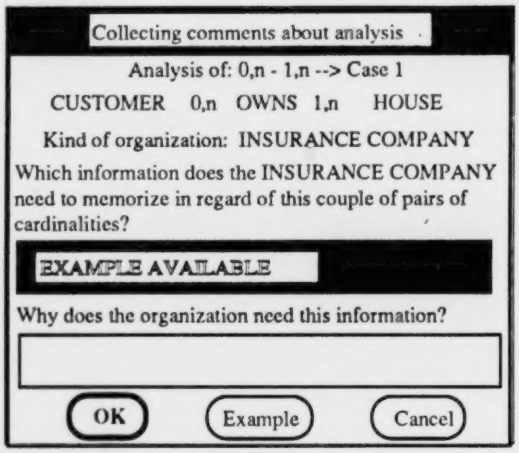
Knowledge acquisition module

The knowledge acquisition module allows the recording of real ERDs. To acquire those examples, experts firstly draw the ERD using the CASE tool (Figure 1). CODAMA's knowledge acquisition module is then made active. It begins by asking the expert to describe the organizational context. A specific part of the ERD is then explained. An example is presented at Figure 6.

In the following example, what an expert described to explain a minimum cardinality 1 is placed between <>.

Given a <manufacture of furniture>. Its clients are <retail shops, persons, and organizations>. This enterprise <makes to order>. When it receives an <order>, the following form is used (Figure 7):

Entities <Order> and <Furniture> and relationship <Concerns> can be identified. An <Order> begins to exist in the memory of the organization when it <Concerns> at least one <Furniture>. That means a minimum cardinality of 1 is necessary.


Collecting comments about analysis

Analysis of: 0,n - 1,n --> Case 1

CUSTOMER 0,n OWNS 1,n HOUSE

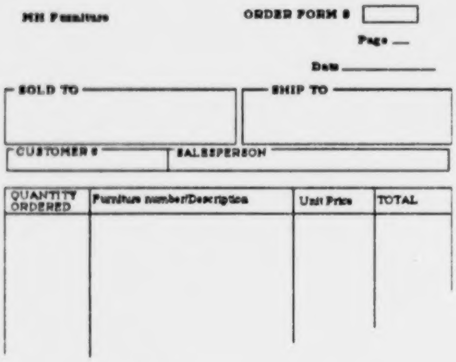
Kind of organization: INSURANCE COMPANY

Which information does the INSURANCE COMPANY need to memorize in regard of this couple of pairs of cardinalities?

EXAMPLE AVAILABLE

Why does the organization need this information?

Figure 6 Example of expert's comments


MH Furniture

ORDER FORM #

Page —

Date

SOLD TO

SHIP TO

CUSTOMER #

SALESPERSON

QUANTITY ORDERED	Furniture number/Description	Unit Price	TOTAL

Figure 7. Order form.

Summary of visual elements

The CODAMA's visual elements are the following:

ERD or part of an ERD is used. Each ERD refers to several kinds of documents used within the organization (such as forms, memos, lists).

Underlined words allow the recall of prerequisites in the short term memory. Learners use the mouse to select the prerequisites to be explained.

A network of prerequisites is presented in different ways. A learner can ask to visualize the explanations related to a particular prerequisite (such as how to find the name of entities). In that case, only a part of the network is presented. Another learner may want to know where she or he is within the network. CODAMA will take into account her or his requests for explanations or identification of mistakes.

A hierarchy of prerequisites can be seen. A learner can ask to which objective a specific question relates. CODAMA will show where she or he is within the hierarchy. Another learner can ask to which objective a particular error relates, i.e., which objective is not mastered. Here again, CODAMA will show the hierarchy to situate the error. In the same way, CODAMA can answer a learner asking what are the prerequisites of a concept or a principle, or where she or he is within the hierarchy.

Conclusion

Students, when asked what is an entity or a relationship, use less textbook like explanations and more examples. So, the advisor favors the transfer of knowledge.

At the end of their curriculum, students have a training period within an organization. More than sixty percent asked to use CODAMA during this training period.

We think that a part of this success is due to the various uses of images and visual cues. They have to be carefully thought and planned during the development life cycle. They are an important part of the advisor's strategy of intervention.

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Analysis of Visual Cues for an Electronic Bulletin Board

by

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Judith L. Schwab

INTRODUCTION

The Hazardous Materials Information eXchange (HMIX) is a national bulletin board sponsored by the United States Department of Transportation and the Federal Emergency Management Agency. The group of professional specifically targeted in this research are local government officials who have an on-going and critical need for information regarding hazardous materials. This group includes local government professional in law enforcement, emergency management, and fire and emergency medical services.

This paper examines what information in this service is of value to local government officials. In addition, I will determine what organizational strategies can be used to make the critical information available on this bulletin board more immediately accessible to local government personnel who use (or would use) this service.

A telephone survey among those who have already accessed the Hazardous Materials Information Exchange bulletin board will provide a description of content material users of this service highly value and do not highly value. Results of this survey will be used to create new "visual cues" and other organizational tools to improve users' access to specific information contained in the information exchange service. Evaluation of alternative screen designs based on observations and interviews with local government materials professional will provide guidelines regarding on-screen information organizers find useful or not. Ultimately this paper will provide suggestions for ways to improve bulletin board presentation formats that can be applied to information services across disciplines.

BACKGROUND

As part of a project sponsored by the U.S. Department of Energy (DOE), Management Systems Laboratories (MSL) at Virginia Tech developed a computer information network to (1) provide information on DOE transportation activities to local communities and (2) support information exchange between local government network members and DOE through a computer bulletin board system (BBS) called the Hazardous Materials Information eXchange (HMIX). MSL was assigned the responsibility to develop and maintain the information to put on a specific menu item (referred to on HMIX as a topic): the DOE/UETC local government network (LGN) topic.

In September 1991, the primary

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contractor, the Urban Energy & Transportation Corporation (UETC), announced to local government network members the opening of the LGN topic on HMIX, briefly describing how to access and use HMIX. HMIX, like all computer BBSs, transmits information over phone lines to anyone who has a personal computer and a modem. The Federal Emergency Management Agency (FEMA) and the U.S. Department of Transportation (DOT) Office of Research and Special Programs Administration are the sponsors of HMIX. HMIX, designed especially for the distribution and exchange of hazardous materials information, has two primary features. The bulletin board feature allows users to view listings of current hazardous materials news items and subjects containing public access information about hazardous materials emergency management, training, resources, technical assistance, and regulations. The message exchange feature allows communication among users through electronic mail and file transfer.

A computer BBS is an effective tool for assisting DOE in providing a centralized channel of easily accessible and current hazardous materials transportation information to every local government network member who has the capability to access HMIX. Local government network members and DOE also have the opportunity to use the computer BBS for exchanging information through messages or downloadable files with one person or many people.

HMIX was selected as the system for the LGN topic for several reasons including:

*Local government network members are part of HMIX's target audience, the community of hazardous materials professionals.

*HMIX provides a 24 hour, 7 days a week toll free access line.

*HMIX does not have any registration or daily usage costs.

*HMIX has 25 other topics which provide information about hazardous materials.

*HMIX seemed easy to use compared to other computer BBSs.

SYSTEM SPECIFICATIONS AND DESIGN CHANGES

The first step in the design process was to understand HMIX's specifications. Once HMIX's specifications were understood, we tried to design the best way of portraying information and setting up methods for the exchange of information among local government network members and DOE. Each specification is briefly described below followed by a description of the design solution.

Ease of viewing an individual screen

The user can only read 23 lines of text on their screen at one time. When many pieces of data are included on more than 23 lines of text, the user will have a hard time understanding the information provided by the data. Also, the user cannot refer back to data that has scrolled off the screen unless they take the time to return to the beginning of the menu and scroll back through to the data they need.

Our solution was to include all the data for a block of information in sections with fewer than 23 lines so the user will not have to start from the beginning of a subtopic and scroll back through pages of data to piece together information from different sections. In this block of information, enough data is given so the user can decide if they are interested in the subject. For users who have a further interest in the subject, we provide brief instructions on how to obtain more information.Other refinements we made to increase readability include:

- Shortening the width of the text on the viewable screen.
- Scrolling new pieces of information to the top of the screen.
- Putting boxes around topic descriptions
- Using bold text

Ease of viewing information on more than one screen

HMIX takes approximately 5 seconds to write 23 lines of text on the users screen. When a lot of information is included on the system, users can be discouraged from using the system because of the time required to scroll through a lot of information.

Our solution was to keep the information divided into small, useful, and easily accessible sections. We divided our subtopics so the categories of information would contain the fewest pages as possible. The small categories of information allow the user to quickly access the piece of information their searching and to quickly scan through the subjects of their choice.

Ease of exchanging messages and other information

HMIX has several very effective means of exchanging information. Users can exchange information by sending electronic mail messages and by uploading and downloading computer files. Messages and files for the same individual can be stored under all 26 topics on HMIX, requiring the user to join each topic to retrieve messages and files. A lot of this information can be lost if the user doesn't know how to find the information.

Our solution was to provide simple instructions to LGN topic users explaining how to read messages, send messages, and download files. The instructions were developed based on the assumption many local government network members are inexperienced computer BBS users. We also recommended users send all messages and files under the LGN topic to help ensure local government members will be able to find information provided by other members and DOE.

Using HMIX

Without the right instruction, a beginning computer BBS user could be easily discouraged from using HMIX. FEMA and DOT provide a manual explaining how to use HMIX with a lot of advanced instructions and additional information the beginner does not need.

HMIX is easy to use for an advanced computer BBS user and the FEMA/DOT HMIX manual suits their needs. So we developed simple instructions to teach the beginning computer BBS user what they need to know to get the full use out of HMIX. We also provided a point of contact at MSL to assist LGN users with any problems they have using HMIX.

Evaluation capabilities

Users can select a menu option to leave comments to the HMIX system operators or they can leave a comment to an LGN topic coordinator through electronic mail. Although HMIX doesn't have the ability to log responses to specific evaluation questions, the HMIX systems operator can program HMIX to report on who is using the LGN topic.

We included a submenu on the LGN topic describing how to leave a comment to the LGN topic coordinator DOE systems operator through electronic mail on HMIX. To track usage, the HMIX systems operator agreed to program HMIX to provide us with a report listing the names of users, how many times they accessed each submenu, and how many files they downloaded.

SURVEY METHODOLOGY AND SUMMARY OF RESULTS

We developed a survey instrument to ask frequent users of Topic 26 their views on the design of that topic, as well as HMIX overall. We selected the top 20 users from a universe of about 100 and conducted 6 complete interviews. Our respondents included an emergency planner, an emergency management director, two transportation specialists, a safety and occupational health specialist, and a reference librarian for an emergency medical service.

The results of the survey included:

* They accessed HMIX on average between 10 and 40 times each month and typically accessed no more than 5 different topics (out of 26 available).

* The users generally accessed Topic 26 to browse, whereas they were more likely to access other HMIX topics seeking specific information.

* Users generally are seeking information they can incorporate into their day-to-day operations. They have very specific needs, ranging from dates for available training to changes in federal hazardous materials regulations.

* Users report sharing information they obtain with a broad range of their colleagues: other local planners and emergency services personnel.

* Users generally felt that HMIX was easier to use than other computer bulletin board systems they typically used but did not feel that Topic 26 was any easier to use than other HMIX topics.

* Most users felt that information on HMIX and in Topic 26 was more up-to-date than other sources of technical information they typically used.

* Most users heard about HMIX by word of mouth, from professional colleagues.

When we asked users to tell us about design features in HMIX they liked their comments included:

* HMIX tells you when you first get access which topics have been updated.

* HMIX has an expert command system.

When we asked users to tell us about HMIX design changes they recommend, their comments included:

* Reduce the amount of time it takes the user to get through the initial screens to start accessing the topics.

* Improve the user's ability to navigate through the system without having to continually go back to the main menu screen.

* Remove the overlap or redundancy among sub-categories.

- Reduce the complexity of uploading and downloading files, which creates problems for beginners.

- Make the expert command codes easier to remember.

CONCLUSIONS/RECOMMENDATIONS

We are receiving positive feedback from people at UETC, DOT, and DOE. The toughest task of the computer information network is getting local government network members to use the system. Our main approach to encourage usage was to design a user friendly system. We designed a system with simple features including:

- Easily viewable screens

- Easily viewable information included on more than one screen

- Easily exchangeable messages and information

- Simple instructions for using HMIX

- Simple evaluation procedures

The survey results suggest that the users of a technical BBS such as HMIX have very different needs from more socially-oriented BBSs. They are willing to browse for specific technical information but would strongly prefer organizational and navigation schemes which allow them to access a system, quickly scan for information, and exit. These preferences suggest recommendations for visual cues for users of highly technical BBSs:

- to quickly identify categories of information in the often long lists of public access messages, for example, subject matter cues for categories such as training, response, safety and accident prevention, and enforcement.

- to retain (even in very reduced size) as a visual reminder to the user which menu area they are viewing.

- to design "visual cues" in a way which can signal similarities or differences in main menu or submenu topics by obvious cues such as color, exterior, or similarity of iconic representation.

ACKNOWLEDGEMENT

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Integrating Visual Imagery Into Workplace Literacy Computer Software

by

Brett Bixler and John Spotts

Overview

Illiteracy is an issue of critical national and international concern. The results of illiteracy are alarming: many adults in the U.S. are unable to participate fully in our democratic, social, and economic systems because of illiteracy (Harman, 1985). Economically, more than 200 billion dollars are spent each year on welfare, prisons, lost productivity, and the like. Even more important is the impact of illiteracy upon the quality of life for those individuals. A functionally illiterate person cannot participate fully in society and make independent decisions as a worker, citizen, parent, and consumer. Internationally, illiteracy is a key issue in economic development and in building the foundation for a free world. No matter how valiant the efforts are to "conquer illiteracy," the reality is that it is too complex and deeply embedded a phenomenon to be easily eradicated.

Current adult literacy instructional programs reach only a small percentage of those in need. Dropout rates from programs are as high as 50 percent; program evaluation is virtually nonexistent. Instruction is performed in many instances by volunteers who receive approximately 10 hours of training. Instructional materials in some cases are reworks of the content of children's curricular materials, thus making it even more difficult to motivate adults to participate. Literacy service providers, both professional and volunteer, have made enormous positive strides against these odds. Individual lives have been changed and enriched as a result. However, in a field without adequate funding, with teachers who are trained to work only with children, with little research to improve practice, and with embryonic systems of networking, the enormity of the problem simply outweighs volunteer efforts.

It is ironic that despite these massive efforts to provide literacy instruction, a sound conceptual and research base has been lacking. Accordingly, valuable resources are sometimes expended for programs and projects that cannot be generalized to other settings. Lacking common understanding about the nature and extent of illiteracy, funding and providing agencies alike are limited in their ability either to learn from the experiences of other programs or to report with accuracy the effectiveness of their own programs. To increase the effectiveness of current and future efforts to reduce illiteracy, a need exists for sound conceptual and research foundations oriented to the information and competence of adult learners.

Growing interest in adult literacy has encouraged the recent development of research studies and innovative programming in the field. In 1985, the College of Education at Penn State established the Institute for the Study of Adult Literacy as a vehicle for using the resources of a major land grant institution to address issues related to adult literacy. The Institute is nationally recognized for its work in literacy research, development, and dissemination activities. The Institute's mission stresses the importance of connecting research to improving practice. Each research project results in a practical application in the field, including staff development activities, curriculum and instructional materials development, policy recommendations, and dissemination of research findings through Institute publications, professional publications, and presentations.

The Institute for the Study of Adult Literacy is unique in its triple purpose:

1) Development and dissemination of a sound conceptual and research base in the field of adult literacy;
2) Improvement of practice in the field of adult literacy; and
3) Leadership and coordination of a comprehensive approach to the delivery of adult literacy services.

Institute projects to date have addressed the following interrelated issues in adult literacy:

1) computer-based instruction
2) workplace literacy
3) family literacy
4) staff development and training
5) special needs populations
6) customized materials development.

A great deal of theoretical research has been incorporated into the design process of the computer-assisted instruction (CAI) the Institute created. Results of numerous research studies reveal that individuals in adult literacy studies increase their test scores and/or grade-level equivalency through the use of CAI (Imel, 1989). Recent software projects at the Institute incorporate the apprenticeship learning model with computer simulation activities. This paper will examine several pieces of software created by the Institute and explain their underlying conceptual foundations and integration of visual materials.

Penn State Adult Literacy Courseware

In the fall of 1984, development of adult literacy software began at Penn State University. The result of this first major software development effort was The Penn State Adult Literacy Courseware. It is designed to help adult beginning readers expand their word recognition.

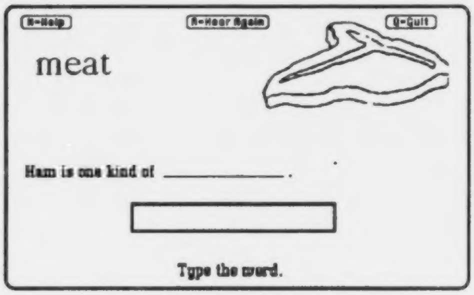
After two years of development, the courseware was field tested in 1986-87 at 46 sites in Pennsylvania using Chapter I sites. Chapter I teachers offered reading and writing instruction using the Penn State Adult Literacy Courseware to instruct the low-literate parents of Chapter I children. At the time, it was the only research project investigating the effects on children when an intervention strategy is used with their parents. The empirical results are impressive; most of the test subjects had gained more than one reading grade level after 20 hours of instruction. (Askov, Maclay, & Bixler, 1986).

This courseware uses a "whole word" approach to teach 1,000 high-frequency and functional words. The goal is expanded word recognition for adult beginning readers. The courseware is interactive, branching and responding to the user's answers and needs. The courseware records learner responses and progress on an individual learner data disk.

Reading vocabulary is divided into four categories: picturable words, non-picturable words, words frequently found on application forms, and words based on high-frequency spelling patterns. These are further divided into groups of approximately 10 words each which form lessons. In all of the modules, the words are taught in context using a speech synthesizer to present multiple-choice and completion exercises to practice recognition of the target words. Word outlines are employed to increase word recognition. The courseware uses branching to permit review and reinforcement. An elaborate record keeping system records and analyzes responses, number of attempts and response time. A file editor allows the instructor to monitor a learner's progress as well as enter new material to supplement the courseware.

The courseware begins with a unit on computer usage (Module 1) designed to acquaint the learner with the speech synthesizer, the commands and the letter/number keys.

Picturable words (Module 2) teaches 250 words. These words are introduced with a graphic (see Figure 1).



meat

Ham is one kind of ________.

Type the word.

Figure 1
Module 2 Example Screen

Non-picturable words (Module 3) teaches 440 words which are introduced using short selections on a variety of topics. Both of these modules include games to reinforce the acquisition of new vocabulary. Computerized pretests and posttests are also found in these modules. The learner is pretested before each lesson with 90 percent set as mastery level. If mastery is not attained, the learner is directed to the instruction and games to help him/her learn the vocabulary. The teacher also has the option of including only selected vocabulary words in the instructional sequence. The learner is posttested upon completion of a lesson. Five forms of each test exist.

Module 4 teaches 140 words commonly found on application forms of all types. The learner practices this vocabulary by filling in an application form with his/her own data, which may be printed as a reference.

Module 5 teaches 170 words which are based on high-frequency phonograms. This module gives practice in word building with consonants being added before 16 common word patterns (such as "ake").

Module 6 (a word processing module) allows the learner to use the words s/he is learning in writing activities. This module is used concurrently with the other modules. In addition, Modules 3 and 6 are customizable by the teacher to include other words and sentences.

R.O.A.D. to Success

Federal legislation mandated that as of April 1, 1992, all commercial vehicle drivers must pass an actual driving exam and a written test to be able to keep or obtain a commercial vehicle driver's license. The written test is designed at a 6th to 9th grade reading level. The intent of the legislation is to increase highway safety, but it has as unintentionally imposed a mandatory 6th to 9th grade reading level on public and private drivers.

The Commercial Driver's License (CDL) exam determines if veteran drivers across the United States will keep their jobs. Approximately five million drivers hold a commercial license nationally. If many of the equipment operators fail the CDL exam, the impact on the economy would be considerable. National trucking associations are projecting a severe shortage of qualified commercial drivers during the 1990s. In fact, the *Pennsylvania Occupational Information System: Labor Demand-Supply Relationship Component (1988)* predicts severe shortages in the transportation industry by 1995. Denying a functionally illiterate but experienced driver a job is not a solution to highway safety.

R.O.A.D. (Real Opportunity for Advancement and Development) to Success is a course of interactive computer software and print-based materials designed to help drivers develop the reading skills needed to study for and pass the national Commercial Driver's License exam.

R.O.A.D. to Success provides approximately 100 hours of instruction at a 4th grade reading level, using two different but parallel methods of delivery. One method uses computer-assisted instruction (CAI) and the other uses traditional classroom instruction. Both methods teach the same content using delivery tools that are appropriate for that medium. Both methods of instruction are designed to stand alone, but a learner is able to switch from one to the other with little difficulty because of the identical content in the two approaches.

The courseware and print materials are based on the study manual produced by Essex Corporation, the company that developed the CDL exam. The materials are written at a 4th- to 7th-grade readability level to help drivers master vocabulary and reading skills they need to understand the manual and test.

R.O.A.D. to Success provides instruction for large vehicle operators on the following topics:

- General Knowledge
- Transporting Passengers
- Air Brakes
- Combination Vehicles
- Hazardous Materials
- Tank Vehicles
- Double/Triple Vehicles

Graphic materials incorporated into *R.O.A.D. to Success* are highly content-specific to the concept taught. Graphics range from a simple truck outline to a complex tractor-trailer air brake system (see Figures 2 and 3).

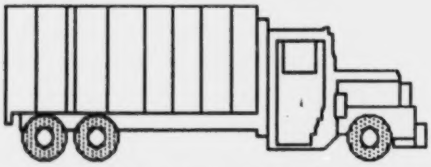


Figure 2 — Truck outline

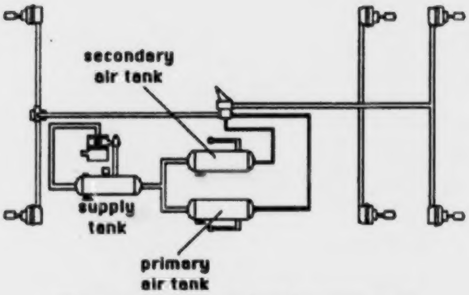


Figure 3 — Air brake system

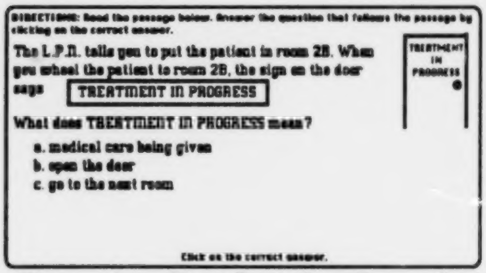
Daybreak

Many adults training for entry-level jobs don't have realistic expectations of the basic skills required to perform those jobs, or know whether their own basic skills are up to par. *Daybreak* helps adults obtain or progress in entry-level jobs by assessing related basic skills in a particular job area and diagnosing their strong and weak basic skills areas. This diagnosis enables the teacher/tutor to provide instruction in those weak areas. Improving job-related basic skills is the keystone of efforts to help adults find or advance in entry-level jobs.

Daybreak is designed for adults reading at about 4th- to 8th-grade levels. The software requires little computer sophistication. Adult learners can run through the program on their own after a few minutes of instruction on the use of the computer.

The courseware is job-specific; it allows adults to assess their basic skills in the context of the job area they wish to enter. Because every specific job cannot be analyzed for the basic skills required, the courseware addresses an array of job-related basic skills, targeted at under prepared adults who have entry-level jobs or who aspire to entry-level jobs. The five occupational areas the courseware addresses are: health care, retail trade, administrative support, food service, and maintenance.

Through computerized examples of problems workers encounter on the job, learners can explore the job area they wish to enter and assess their basic skills in the context of that field. Explanations are given immediately for incorrect answers, providing opportunities for learning during the assessment. Graphics are limited to those relevant to the current question. For example, questions assessing the comprehension of a sign include a graphic of the sign; questions about forms include a graphic of the form itself (see Figures 4 and 5).



DIRECTIONS: Read the passage below. Answer the question that follows the passage by clicking on the correct answer.

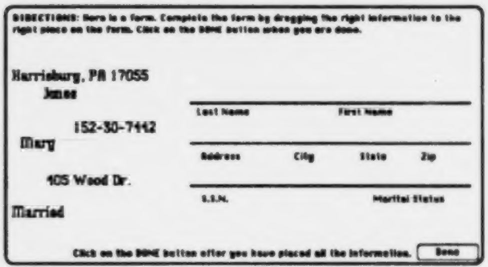
The L.P.N. tells you to put the patient in room 2B. When you wheel the patient to room 2B, the sign on the door says TREATMENT IN PROGRESS

What does TREATMENT IN PROGRESS mean?

a. medical care being given
b. open the door
c. go to the next room

Click on the correct answer.

Figure 4 — Sign Question Example



DIRECTIONS: Here is a form. Complete the form by dragging the right information to the right place on the form. Click on the DONE button when you are done.

Harrisburg, PA 17055
Jones
152-30-7442
Mary
405 Wood Dr.
Married

Click on the DONE button after you have placed all the information.

Figure 5 — Form Question Example

Blue Shield

This software is being designed to produce a comprehensive, industry-centered, model basic skills program to provide entry-level Blue Shield of Pennsylvania workers and trainees with the basic skills necessary to succeed in the workplace. Because the project focuses on the basic skills needed in claims preparation and processing, the curriculum and materials produced will be useful to other medical insurance industries across the United States. The model curriculum and materials will be especially useful to the overall network of various Blue Shield-owned companies.

The skills targeted in the course will also provide the basis for employees' upward mobility in the workforce. Blue Shield supervisors report a growing need for employees who are adaptable, especially relating to the use of technology, and adept at problem solving. The proposed training will address these needs and provide the training support needed to further the employment possibilities for Blue Shield entry-level workers.

The course, developing basic skills using content specific to the medical insurance industry, will include computer-based instructional materials, assessment instruments, and an instructor's guide.

The software uses a real-life scenario, or task approach. The learner must accomplish the given task, utilizing appropriate resources such as forms, manuals, dictionaries, etc.

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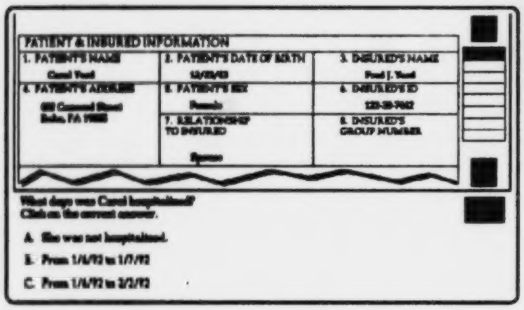
Instruction is always available to assist the learner. The controlled use of graphics is confined to just what is needed to accomplish the task. In one module, the learner must read several different medical forms and answer relevant questions about each form (see Figure 6). When reading forms, the forms themselves are available on the computer. In another module, the learner must update a manual with new information. The manual is on the computer for this module. The student is encouraged through rehearsal strategies involving visual feedback to locate quickly the appropriate information field.



PATIENT & INSURED INFORMATION

1. PATIENT'S NAME [illegible]	2. PATIENT'S DATE OF BIRTH [illegible]	3. INSURED'S NAME [illegible]
4. PATIENT'S ADDRESS [illegible]	5. PATIENT'S SEX Female	6. INSURED'S ID [illegible]
	7. RELATIONSHIP TO INSURED Spouse	8. INSURED'S GROUP NUMBER

What days was Carol hospitalized?
Click on the correct answer.

A. She was not hospitalized.
B. From 1/6/92 to 1/7/92
C. From 1/6/92 to 2/2/92

Figure 6 — Forms on the computer

A Day in the Life . . .

This courseware is designed for low-level (grades 3 to 7) readers. Using this courseware, learners perform actual projects encountered in "a day in the life" of a worker. *A Day in the Life . . .* is divided into six modules of instruction. Module 1 teaches the learner how to use the computer. Modules 2 through 6 teach the most common basic skills required for the food services, health, maintenance, retail, and clerical job areas. The five different career modules allow learners to choose the job that most interests them.

Each job area is divided into several scenarios, or tasks, the learner must accomplish. In Module 4 (maintenance), for example, one of the scenarios is "Paint a Room." Within a scenario, the learner must maneuver through the environment (by use of a map), acquire the objects necessary to accomplish the task, read and fill out the proper forms, perform the task, etc. (see Figure 7).

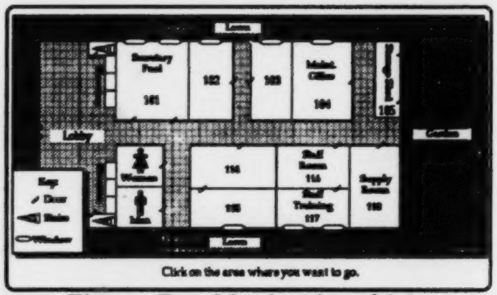


Figure 7 — Navigational Map

If the learner is stuck along the way, s/he can obtain a variety of help, including a full lesson on whatever is giving him/her difficulty. As this software is a simulation of real-life occurrences, critical thinking skills are needed, in addition to the literacy skills the learner must learn. This software is rich with graphics. Each "scene" the learner visits is designed to look as real and as three-dimensional as possible (see Figure 8).

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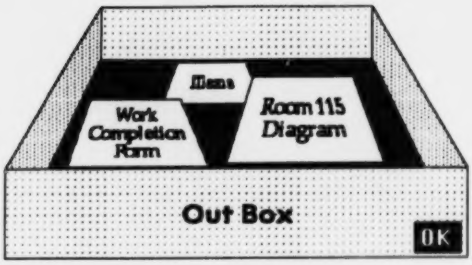


Figure 8 — Three dimensional graphic

The learner can examine, close-up, many objects, like manuals, cash registers, etc. Icons, or small pictures representing a single action the user can take by activating them, are used throughout the courseware (see Figure 9).

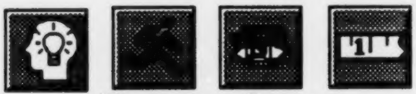


Figure 9 — Icons

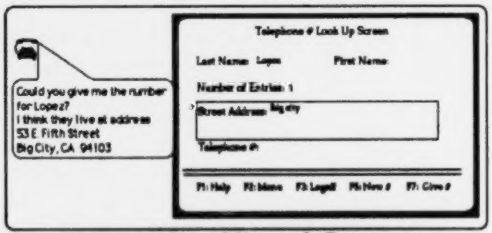
Learner data disks provide detailed printouts of each learner's performance on assigned job tasks. This simple management system pinpoints areas where learners are encountering difficulty. The learner's progress is keyed to a basic skills list, which allows the teacher to decide easily those subjects the learner needs to master.

AT&T Software

This software implements a job-related literacy training program that prepares adults for telephone sales and customer service jobs in the private and public sectors. The training program, called the *Telephone Sales & Customer Service Training Program*, will teach job-related basic skills to people lacking the skills they need to qualify for telephone sales and customer service jobs.

The software looks at four different types of jobs: working for a telephone company; working for a credit card company; working for a bank; and working for an insurance company. Each job classification is divided into information sharing, simple customer contact, complex customer contact, and sales.

This software borrows many of the concepts used in *A Day in the Life . . .* courseware. Learners must accomplish a variety of tasks, which are presented through visually rich scenarios. In Information Sharing for a telephone company, for example, a "virtual computer" is modeled on the screen (see Figure 10).



Could you give me the number
for Lopez?
I think they live at address
53 E. Fifth Street
Big City, CA 94103

Telephone # Look Up Screen

Last Name: Lopez
First Name:
Number of Entries: 1
Street Address: big city
Telephone #:

Figure 10 — Virtual Computer

Learners see the virtual computer screen and interact with it, as well as receiving instruction and prompts from the real computer. The task is to give the customer a telephone number, using information the customer provides to look up that number in the virtual computer's database. Other scenarios follow a similar format.

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Theoretical Concepts Used in Institute for the Study of Adult Literacy Software

Institute for the Study of Adult Literacy software or courseware is designed to assist low-literate adult learners in obtaining basic literacy skills. The software presents each concept on highly visual screens, which include interactive activities designed to enhance learning (Gay, 1986; Carey, 1990).

Institute for the Study of Adult Literacy software uses the *functional context approach* to instruction. Research in the 1980s indicated that functional context instruction—instruction using the context of relevant work or life tasks—is effective in improving basic skills for the workforce (American Society for Training and Development, 1989; Sticht, 1987). Workplace literacy programs have been among the most prominent examples of functional context education in the field of adult literacy.

Functional context methods of instruction are especially effective and valuable for at least two reasons:

- Like on-the-job training, functional context instruction centered around work-related skills is clearly relevant to the adult learner's life. Thus, functional context instruction is a motivating factor. Harman (1985) suggests that "hard-to-reach" adults are best reached in programs where literacy is not the main goal but a tool to reach other goals. Functional context instruction has more intrinsic value to the learner (Sticht, 1987).

- With prior job knowledge and life experience, workers can read and interpret job-related materials several grade levels higher than they can read non-job-related materials (Mikulecky & Ehlinger, 1986). This because the terminology is familiar and the concepts are those worked with daily. Thus, if a program aims to improve work-related literacy skills, it would be counterproductive for learners to work with generic materials when they could be working at a higher level with job-related materials.

The Institute's software, using the functional context approach, teaches and reinforces the specific literacy skills needed by using the content of the job area as a basis for all instruction (Lajorie & Lesgold, 1989). The learners see the relevance of the instruction and are able to learn and retain the information better because it relates directly to their on-the-job experience. It capitalizes on their background knowledge from work experience, and enables them to improve their reading comprehension with familiar materials.

The design and development of the Institute's software is based on well-established current learning and psychological theories incorporated into an interactive computer-assisted instructional environment (Tennyson, 1990). Following is a description of key instructional components in the Institute's software:

- The Institute for the Study of Adult Literacy's software is written knowing that adult learners are different and unique in their needs (Baker & Bixler, 1990). Software needs of pre-adults differ from those of the adult population, which is trained and retrained. Adult learners are extremely goal-oriented. The software reflects the requirements of employers of a given locale (Zahniser, Long & Nasman, 1983). It also reflects the perceived needs of the learner.

- The organization of instruction is visually appealing to keep the learner's attention (Hannafin & Peck,1988). An graphic artist is used to establish aesthetically pleasing screen layouts (see Figure 11). The instructional designer assures the content "flows" from one concept to the other.

Figure 11 — Quality art

- Screens are "sparse" in terms of content density wherever possible. A segment of instruction is broken into small, discreet steps presented sequentially (Baker & Bixler, 1990). This results in screens with a great deal of white space (an area free of information). Instead of diversifying the learner's attention, the screens are clutter-free, allowing the learners to concentrate on the concept intended. Unnecessary distracters are removed from the screen. Illustrations are chosen and properly placed to make the text more meaningful and reduce the burden of details in the text (Dwyer, 1978). When teaching a concept about trucks, for example, if the graphic was a truck and several cars, the cars are removed from the graphic unless they are essential to the instruction (see Figure 12). Use of simple line drawings without any extra detail, shading, or fill patterns enhances the concept.

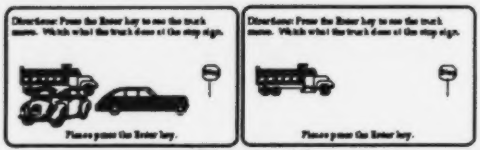
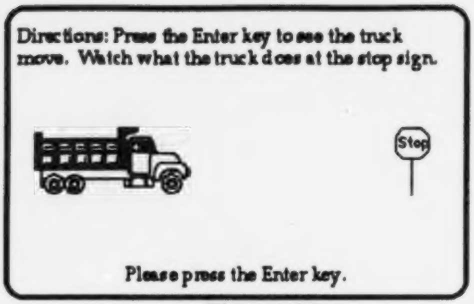


Figure 12
Removing unnecessary visual distracters

- The Institute for the Study of Adult Literacy's software uses large text sizes for text wherever possible (Baker & Bixler, 1990). Most text in books and magazines is 10 or 12 point. The Institute's software uses at least 14 point text. Ideally, an 18 or 24 point size is used because learners may have a visual impairment. The use of large text sizes also limits the amount of information placed on one screen.

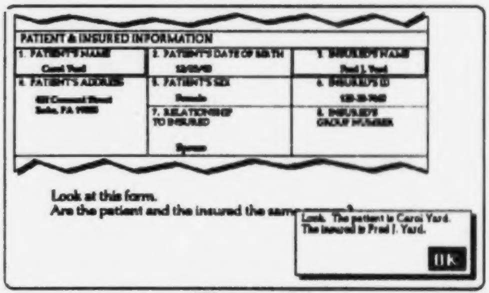
- Directions and help are constantly provided (Baker & Bixler, 1990). One element many low-literate adult learners share is a difficulty in following directions. Directions are always visible or easily accessible. Learners are prompted step-by-step through difficult exercises. Mirrored prompts are used whenever possible. An example of mirrored prompts is having a set of directions at the top of the screen with an additional "What do I do next?" prompt at the bottom of the screen (see Figure 13).


Directions: Press the Enter key to see the truck move. Watch what the truck does at the stop sign.

Please press the Enter key.

Figure 13
Example of mirrored prompts

- Placement of directions and graphics on the screen are consistent wherever possible (see Figure 14). The learner-computer interface is critical. Common phrases for all directions are used. Graphics appear in the same general area on the screen in sequential exercises where new graphics may replace old graphics. All menus, interactions, etc. that a learner must do to use the program successfully are standardized. Even literate people have difficulty with an inconsistent interface. Providing an explicit organization increases the memorability of new material (Bower, 1970).


PATIENT & INSURED INFORMATION

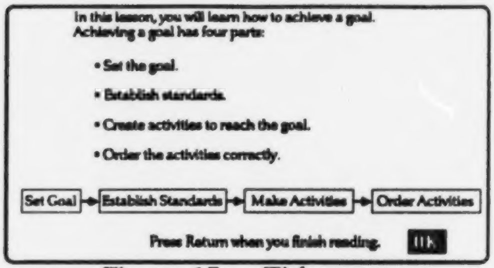
1. PATIENT'S NAME Carol Yard	2. PATIENT'S DATE OF BIRTH [illegible]	3. INSURED'S NAME Fred J. Yard
4. PATIENT'S ADDRESS [illegible]	5. PATIENT'S SEX Female	6. INSURED'S ID [illegible]
	7. RELATIONSHIP TO INSURED Spouse	8. INSURED'S GROUP NUMBER

Look at this form.
Are the patient and the insured the sam

Look. The patient is Carol Yard.
The insured is Fred J. Yard.

Figure 14
Consistent Feedback Placement

- Title screens (see Figure 15) notify the learner when a new section is being presented (Murray, 1989).

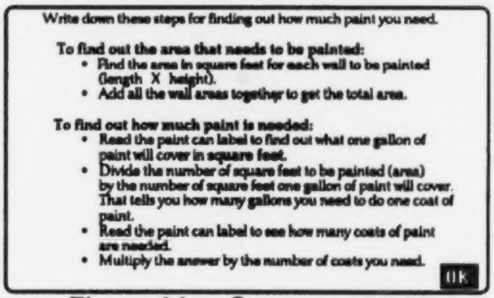

In this lesson, you will learn how to achieve a goal.
Achieving a goal has four parts:

- Set the goal.
- Establish standards.
- Create activities to reach the goal.
- Order the activities correctly.

Press Return when you finish reading.

Figure 15 — Title screen

- Summary screens (see Figure 16) inform the learner that a section is finished. Summary screens also organize and provide a synopsis of the material presented. Summary screens often mirror a title screen, occurring after completion of a section of instruction.


Write down these steps for finding out how much paint you need.

To find out the area that needs to be painted:

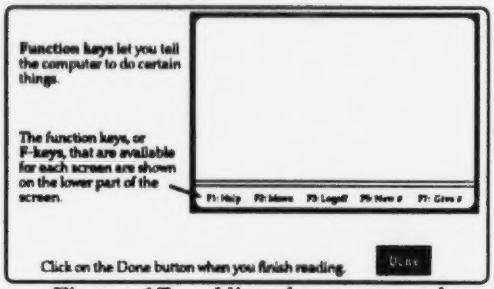
- Find the area in square feet for each wall to be painted (length X height).
- Add all the wall areas together to get the total area.

To find out how much paint is needed:

- Read the paint can label to find out what one gallon of paint will cover in square feet.
- Divide the number of square feet to be painted (area) by the number of square feet one gallon of paint will cover. That tells you how many gallons you need to do one coat of paint.
- Read the paint can label to see how many coats of paint are needed.
- Multiply the answer by the number of coats you need.

Figure 16 — Summary screen

- All content presented in the software is accompanied by visual cues (Hayes & Henk, 1986; Bean, Singer, Sorter, & Frazee, 1986) to enhance learning (see Figure 17).

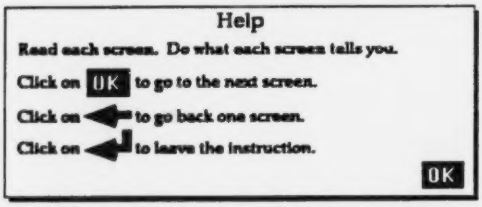

Function keys let you tell the computer to do certain things.

The function keys, or F-keys, that are available for each screen are shown on the lower part of the screen.

Click on the Done button when you finish reading.

Figure 17 — Visual cue example

- A variety of learner-control features are provided on each screen (see Figure 18), allowing the learner to select numerous learning or support options.


Help

Read each screen. Do what each screen tells you.

Click on OK to go to the next screen.

Click on to go back one screen.

Click on to leave the instruction.

Figure 18 — Learner controls

Icons, or small pictorial representations of an action the learner can take are available at all times. When the learner activates the icon, the corresponding action takes place. Thus, the Institute's software is learner controlled and individualized (Gay,1986). These features are as follows:

- A "notebook" (pull-down word processor) feature is available for the learner to keep notes for later reference (see Figure 19). The learner may print out the entries made. The teacher may also use this notebook as a writing diagnostic tool.

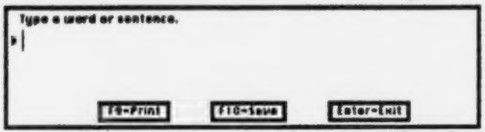

Type a word or sentence.

Figure 19 — Student notebook

- A "navigation" feature allows the learner to browse forward or backward from screen to screen (see Figure 20).

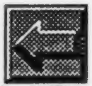
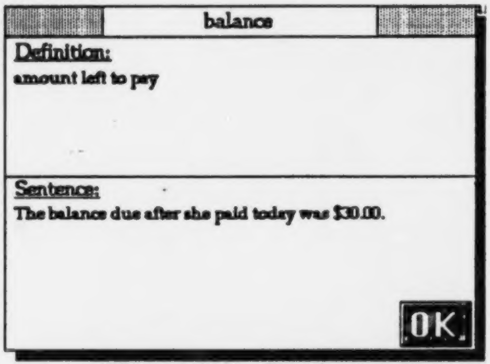


Figure 20 — Browse icon

- The Institute's software features on-line help in order to support the learner throughout the program. By selecting this option, the learner can choose to receive help on how to use the computer system or help with the functions and features of the Institute's software.

- The Institute's software contains a built-in dictionary which a learner can access at any time (see Figure 21). It shows the word, provides the definition of the word, and uses the word contextually in a sentence.


balance

Definition:
amount left to pay

Sentence:
The balance due after she paid today was $30.00.

Figure 21 — Dictionary

- The learner can quit the Institute for the Study of Adult Literacy software at any time (see Figure 22). To insure the learner did not accidentally select the quit option, a pop-up window appears in order to verify the learner's request before quitting the program. An electronic "bookmark" allows learners to return to where they left off when they start the next session.

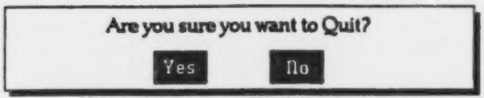
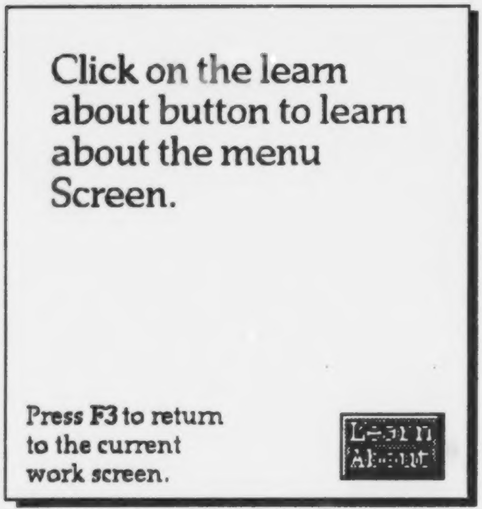

Are you sure you want to Quit?

Figure 22 — Quit prompt

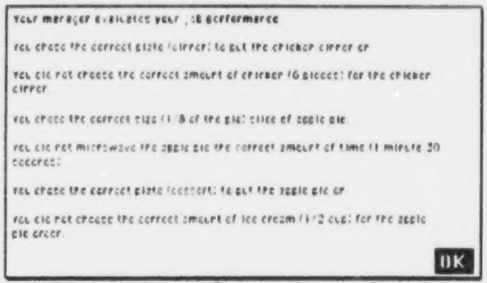
- In scenario-based activities (where the learner must accomplish one or more real-life tasks), when learners select the "learn" feature, they are provided a variety of interactive activities that are related to the learning concept being presented (Hamburger & Lodger, 1989) on the screen (see Figure 23).


Click on the learn about button to learn about the menu Screen.

Press **F3** to return to the current work screen.

Figure 23 — User learning option

- The assessment tracking system built into the Institute for the Study of Adult Literacy's software tracks the pathways taken by the learner (i.e., whether the learner chose to review the information screens alone or information screens and activity screens). The tracking system also allows the program to inform the learner of what materials to review before proceeding, whether the learner should partake in the learning activities, and whether the learner should seek outside assistance. Thus, the Institute's software offers metacognitive guidance (see Figure 24).


Your manager evaluates your job performance

You chose the correct plate (dinner) to put the chicken dinner on

You did not choose the correct amount of chicken (6 pieces) for the chicken dinner

You chose the correct size (1/8 of the pie) slice of apple pie

You did not microwave the apple pie the correct amount of time (1 minute 30 seconds)

You chose the correct plate (dessert) to put the apple pie on

You did not choose the correct amount of ice cream (1/2 cup) for the apple pie order.

Figure 24 — Scenario evaluation

Conclusions

The simulated apprenticeship learning environment acts as a bridge between the theoretical learning of conventional learning and the actual practice of the work environment (Resnik, 1987). Computer simulations provide a real-world learning environment for the learner to apply many skills that are taught using known and proven learning theories. Imagery in the simulations plays an important role in assisting the learner to combine certain processes, such as spatial and cognitive processes, with the visual processes used in recalling tasks (Robertson & Lamb, 1991).

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Visual Simulations: Why We Need Pretty Pictures

by
Don Stredney

Introduction

The practice of using computers to previsualize, diagnose, and teach complex biomedical phenomenon is in its infancy. As technology grows, the possibilities for our elucidating the phenomenon of man are rapidly expanding. The ability to create a virtual representation of our world and to perform untold operations to that model, has lead to new areas of scientific, artistic, and educational inquiry. The ability to generate virtual simulations may possibly prove to be one of the most significant developments of our century.

This paper discusses the issues of representation in the use of scientific visualizations, specifically those used for biomedical applications, and the implications of those issues to interface design.

Virtual Reality - Improved Methods for Information Exchange

With the emergence of most new technologies there follows a period of unrestrained claims of promise. Fortunately, with time, a more sober disposition prevails and our perceptions of the technology are tempered and become more realistic. In order to demythologize new technologies, we must democratize them. As with the personal computer, by democratizing virtual technology, we shall come to see what washes out, and what bears out.

Recently there has been an increased interest in these technologies that enable individuals to create "virtual realities" (VR), "synthetic realities" or "virtual environments". The benefits of research into the generation of virtual simulation are obvious. The application of computer graphics for simulating flight have improved flight training significantly. However, certain questions remain: How realistic does the imagery need to be? Where does significant image quality become a hinderance to comprehension and transfer, and where and how does it facilitate the process?

There is mounting interest in using computer technology for creating surgical previsulizations [1][2]. The implications of creating imagery from various imaging sources and providing a non-threatening environment for clinical exploration and education are profound.

However, the current level of the quality of graphics is limiting. Graphics produced by the best VR systems are rather crude, although they are produced in real-time. In order for the technology to become practical to the medical community, the quality and level of representations will need to be greatly improved.

Importance of Realism

A common retort one will often hear when discussing the quality of computer generated images is "We're not just interested in pretty pictures". Somehow it is perceived that images that contain both a high level of technical and aesthetic achievement are fancy, cute and unnecessary, and that the embellishments are distracting and superfluous. This "unnecessary" information, however, may assist the individual in assimilating novel information by contributing visual and temporal cues that create a meaningful context for the content.

Computer technology and algorithm development have reached a state where sophisticated imagery can readily be attained, some in real-time. Images that include detailed spatial and color cues, as well as motion, convey information that the brain expects to see. It is this additional "fluff", as it is often pejoratively termed, which facilitates the brain to rapidly encode the image.

This does not mean to say that all imagery must convey all perceptual cues. Motion may not be required for full comprehension. The elimination of certain cues can create an interesting image, a cognitive closure if you will, that can engage and further stimulate the brain. Such examples may be found within the rich and varied history of art and design.

Recent investigations have explored levels of representations for facilitating learning, most specifically computer generated imagery [3]. Foley has demonstrated that there is a limit to the perceptual cues needed by an individual to do certain recognition tasks [4]. In his study, faceted shaded objects allow the user to match a structure with its rotated counterpart, by an increase of 20 percent over hidden line. Smooth shaded objects, however, offered no improvement for recognizing rotated objects.

More recent research by Lintern has shown that simple graphics may be more helpful to novice flyers when using simulations, and that they may actually reduce practice time by 15 percent [5]. Lintern suggests that the realistic displays may be too distracting for the user and sometime overwhelm them, causing them to panic. This may be true; however, the question may be asked "When do you need increased realism to convey a more accurate depiction of the task?" Eventually one would want to train on a system that provides enough realism in the simulated environment to maximize transfer to the "real world" situation. Experts may subtly (intuitively) use nuances in the environment to effectively assess and interact with their environment.

Importance of Realism to Medicine

It has been more difficult to convince radiologists to become interested in utilizing three dimensional reconstructions from imaging techniques that it has been to convince surgeons. This is not meant to be disparaging towards radiologists. Most radiologists are trained to discern information from two dimensional imagery. From practice and experience, they have developed an incredible acuity to transform two dimensional information into three dimensions. However, surgeons may not share this discernment. They do not interact with two dimensional images, they interact with three dimensional structures, often of incredible complexity.

Surgery, like anatomy, is a visual art. Both require the utilization of dimensional perception for comprehending the structures. It is difficult for surgeons to transfer information based upon two dimensional images into a three dimensional referent, a latent, or stored representation as defined by Crick and Koch[6]. It is this latent representation with which they will correlate their actions.

In the application of computer graphics to biomedical simulations, the need for realism is obvious. The task is to create the most accurate representation that requires minimal transfer. . Complex reticular structures such as the brachial plexus, or regions of the vascular system may require motion to understand the structure adequately. Still images, and images with limited perceptual cues, are inadequate for discerning structural complexity.

Clinical medicine and medical education would be greatly facilitated by using realistic three dimensional referents The dimensional complexities that confronts the surgeon are immense. A common fear of many surgeons is to hear themselves say "I wish I would have known this situation before I opened the patient". The creation of virtual simulations can greatly aid surgical investigation, providing a non-threatening environment for exploration and planning. This is certainly a situation where the fewer surprises, the better.

Surgeons and other clinical investigators whose domains lie in three dimensions are very enthusiastic about the application of three dimensional graphics and simulations to their research and practice. Many surgeries considered inoperable in the past are now becoming tractable. If one has an accurate map with which to build a latent representation, one feels more comfortable in entering hitherto unchartered territory.

Importance of Realism for Transfer

The brain is a wonderful marvel of evolution, an organ that embodies several complex systems that construct a representation of the world around us. As we compare active representations, representations directly perceived, with latent representations, context becomes extremely important. For the context in which something is viewed affects the way in which it is perceived. By creating more sophisticated imagery, we may facilitate the brain's ability to assimilate novel information by introducing cues that establish links to internally held contexts. These realistic cues may provide the difference between learning and experience. They may aid the individual in participating with content as described by Kay[7]. When the intent is to convey complex and recondite information such as is required in biomedicine, perceptual cues which elucidate the form and context of structures may be essential for the rapid encoding of complex information.

Within a certain domain, most of our perceptions are similar. However, beyond that domain, our perceptions are unique, defined by the unique experiences that each of us undergo. What is required is an interactive interface that permits the individual to titrate the level and complexity of the visual cues provided in a simulation. Studies in cognitive neuroscience have demonstrated physiological mechanisms for individuality[8,9]. We should take advantage of the flexibility of the computer and create interfaces that allow the user to individualize their environment in order to augment their mental capacities. In this way, the user can create the level of realism which provides the visual schema that best suits their understanding and transfer of new information.

Summary

Current theories of perception and cognition maintain that reality is a construct of the brain, that the shared reality we experience may be due to equivalences in genetic makeup. In our shared perceptions, the way in which we see the world represents the brains way of creating representations of our existence that are meaningful. If so, by creating imagery that mimics the way we see, we may augment the assimilation of new information. By building referents that build on natural representations, we may be facilitating the sharing of information across disciplines.

Genetic makeup, however, is congruent only to a degree, and as experiences are unique, so too are the methods in which we perceive. Discoveries in neuroscience have provided a model for the biological expression of individuality. We should respect this diversity and nurture it, for the ability to see the world in new ways provide us with a mechanism of change, a mechanism for both collective and individual growth.

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Special Experiences for Exceptional Students: Integrating Virtual Reality into Special Education Classrooms

by
Erez Cedric Miller

Introduction

Classroom. The walls are covered with posters, pictures and bulletin boards. Eight students are sitting on their chairs. Some of them are gazing at the teacher. Others look as if they are concentrated in a world of their own. Two of the students are sitting in wheel chairs.

"Students", the teacher announces, "today we are going to visit a forest. I want everybody to put his or her eye goggles on, and I am going to help you to connect your data suits to the computer."

The teacher then helps those who need some help to put their equipment on... In a blink of an eye, the scene changes. They are all in a big forest, surrounded by green trees, bushes, wild berries and birds. "Now, let us get closer to see the leaf over there." One by one the students fly up, until they all end up on a huge leaf...

None of the students has ever left the classroom during the trip to the forest. Yet they all learned and experienced leaves that have different shapes, how they grow and shrivel, and how they change their colors in the fall. The entire scene took place in *cyberspace*. Will such a scene actually take place in the learning environments of special education classrooms of the twenty-first century?

The purpose of this paper is to discuss some of the potential benefits and hazards that virtual reality holds for exceptional children in the special education system. *Virtual reality* is a computer-created environment that replaces the normal sensorial input received by its user. Helsel (1992) adds that "Virtual reality requires hardware and software that furnish a sense of: (1) Inclusion...(2) Navigation, and (3) Manipulation." (P. 39).

While *virtual reality* refers to the technology, *Cyberspace* is the actual place where the interface between the human nervous system and the computer's computation and communication systems takes place. It is a place that takes no space in our physical reality.

Before we start, however, we must consider several issues that pertain to special education. First, special education is defined in this paper as consisting of various student population with a wide range of abilities and difficulties. Some of the students are sensorially challenged (e.g., blind) and\or motorically challenged (e.g., children with Cerebral Palsy), while others are mentally retarded, behaviorally or emotionally disturbed. Students can also have one or more of the above conditions concomitantly. Consequently, each student must have his own individual educational program, tailored to his specific needs and abilities.

Why virtual reality?

Many teachers in special education describe their students as lacking experiential background. The experiential deprivation can be caused by sensory deprivation (blindness, deafness), by physical immobility, by communicative difficulties or by many other conditions that restrict the exceptional child's repertoire of experiences. The experiential deprivation further leads to academic and social deficits.

Cyberspace is the ultimate experience as we conceive it today. It is a world in which pure information will be heard, felt, smelled and, of course, visualized. Thus, it is especially appropriate for experiential learning.

Increasingly, research findings report that experiential learning is more effective and is retained by the students for a longer time. Lowenbrow and Barbee (1990) suggested that intelligence and expertise must interact with the environment; that individual learner characteristics must be considered when constructing a learning environment; and that learning must be embedded in a meaningful context. They also suggest that the transference of the acquired skills and knowledge is more likely to happen if learning took place in a meaningful environment. One cannot overemphasize the importance of contextual embedding to special education. Abstract reasoning and symbolic representations are often too difficult for exceptional students to perceive, acquire, retain and transfer. By developing new theories and implementations, we can increase the effectiveness of special education.

Developing academic skills via cyberspace

Some students in special education, for example, encounter great difficulty in trying to understanding the *symbolic representations* of objects and processes. Difficulties can also arise when these students try to read texts (which are printed symbols). Teachers can use cyberspace as a means to guide the child to various sources of information. This information will be presented in the most appropriate media to the child's understanding, mode of communication and sensory perception. The multisensorial experience in the forest that we illustrated earlier, will to be more effective for their learning than presenting pictures or verbal explanation about the leaves. In virtual reality objects can be maximized if their real-life size is too small (e.g., living cells) or minimized if they are too big (e.g., skyscrapers). Processes, such as the leaves changing their colors in the fall, or the development of planets or the growth of plants can be catalyzed so the students will be able to watch the process taking place in front of their eyes. Fast processes or movements such as the bee's flight, can be decelerated to a speed that can be perceived by the child.

In a history class, for instance, instead of *talking* about ancient Egypt, showing pictures or even films, the teacher can take the student on a trip to a virtual ancient Egypt. Suddenly, the abstract stories about the pyramids will be visualized, and the magnificence of the Sphinx will be perceived with full appreciation. Stories and literature can be played by virtual actors, and students will actually be able to take part in the poems and stories they study. Subject matters which today are beyond the reach of exceptional students because of their abstract nature, will be perceived and experienced in cyberspace.

Those exceptional students who experience their learning through the multisensory media of cyberspace are likely to retain their experiences for a longer time. They will also be able to transfer the knowledge they acquired to novel situations. If 'knowing' will be directly connected to 'doing' and 'experiencing', as Lowenbrow and Barbee (1990) suggest, "Schools...(will) need to change what, how, when and who they teach" (Lowenbrow & Barbee, 1990, p.3). Later we will discuss the required changes in the curriculum that will have to take place if we integrate virtual reality into our special education classrooms.

Vocational training

Special education at the high school level is often geared toward vocational training. Virtual reality can provide an excellent medium for training the student in a secure environment. When training mentally retarded students, for instance, the learning process must be turned into an *active* one. Fritz (1991) asserts that for both adults and children virtual reality could help make information more concrete by linking abstract ideas to tangible physical objects or symbols. Two advantages jump to mind when we consider incorporating virtual reality into training sessions. First, instead of buying expensive machinery, the trainer could reconstruct a virtual machine in cyberspace that will simulate the real machine, and save the school a significant amount of money. Second, some machines in the physical world can be hazardous if their operator is not fully skilled, hence these machines cannot be used in the training process itself. Virtual reality can compensate for this drawback, as the student can practice operating the virtual machine again and again without being in danger. Even the most fatal mistakes can be corrected and reconstructed repeatedly, until the student has fully mastered the required operational skills.

Social learning in cyberspace

Previously we discussed the promise that virtual reality holds for developing the academic abilities and vocational skills of exceptional students. Yet many of these students also encounter serious difficulties in the social domain. In the past researchers and teachers tried to train the child in those skills he or she is lacking. Often they reported that transference to novel situations outside the classroom was only partial, if it occurred at all.

Transference of acquired social skills to novel situations is hampered because the classroom environment does not successfully emulate real-life social problems.

The idea of mainstreaming exceptional children into regular public schools originated in social learning theory. The idea was that if exceptional students were exposed to and interacted with "normal" students, they would imitate their peers' social behaviors. Today the educational system has slowly begun to sober from this euphoristic vision. Often, even if the exceptional child was academically successful, he remained socially isolated, as happened in the many cases of deaf and hard of hearing students over the past 15 years. In cyberspace, social skills and behaviors, as well as whole virtual social situations, could be practiced within the secure boundaries of cyberspace. What is required is to construct simulated social situations in which the student will interact with cyberpsychically digital life forms.

The new forms that society, culture and socially consensual behavior will take in cyberspace lead us to reexamine our current social and cultural framework. Stone (1991) discusses "social spaces in which people will still meet face-to-face, but under new definitions of both "meet" and "face". These new spaces instantiate the collapse of the boundaries between the social and technological, biology and machine, natural and artificial that are part of the postmodern imaginary." (p. 85).

Before we start teaching our students the codes of society and culture, we must ask ourselves which codes of what culture do we wish to teach - the cyberspatial or the 'real' one. This question must be addressed before we attempt to experiment with students who will a need highly constructed and consistent environment.

Telepresence and distance education

With the introduction of telecommunication and telepresence, schools will have to reconstruct their conception of the traditional classroom structure. After all, there is no necessity that all the students in the virtual classroom will occupy the physical space. This situation will enable a student who resides in remote places to receive education from highly qualified teachers and experts without having to travel great distances at great expense. We must also remember that school personnel in special education do not merely consist of teachers. Physicians, neurologists, speech therapists and other professionals provide services to exceptional students as well. Through telepresence and highly sophisticated data suits, experts from all parts of the world will be able to provide services to students in remote places.

The role of teacher in cyberspace

When computers were first introduced to schools in the early eighties, many believed that computers would rapidly replace the teacher's role in the classroom. Those who held the view of computers as the ultimate tutoring agents have since sobered. The teacher had, and will continue to have, a significant role in the student's learning environment. However, the traditional role of the teacher will have to change dramatically. Instead of being the sole or major source of information and its representation, "the teacher will inspire, motivate and serve as referee for the human-to-human discussions that computerized instruction is designed to evoke" (Lemonick, 1992). Education, rather than being unidirectional, will evolve to be a reciprocal process. The teacher will become a facilitator, a guide, rather than keep his traditional role as an "instructor".

Changing teacher-training programs

One, obviously, cannot anticipate a drastic change in the traditional teacher's role without a preceding radical change in teacher-training programs. There are two fundamental issues that we must conceive before this change begins. The first is the role of the teacher as a *facilitator*. Rather than focusing on learning *how to teach* subject matters, teacher trainees will focus on *how to construct* experiential learning environments, by using advanced technology. The second issue is directly linked to the first one. Until today, many teacher trainees have hardly any hands-on experience with existent technologies such as multimedia and computer networks - not to mention virtual reality. Greater accessibility to technology will not suffice, naturally. Courses in 3-D graphic design and cyberspatial architecture will have to augment the teacher training program to enable the trainees to experience and learn how to construct virtual learning environments.

The corollary curricular change

Not only the teacher's role and the teacher's training will have to change conceptually before we integrate virtual reality into our classrooms. We must also shift our focus from *teaching* to *learning*. Learning in the sense of controlling one's environment, of learning *how* to learn. Learning in the sense of knowing how to *gather* and *sort* information, how to navigate through the ever-accumulating sea of information. "Knowledge navigation", which was coined by James Dezell, president of EduQuest (a division of IBM) appears to be the appropriate term for that type of learning.

Virtual reality can be a highly distractive environment for certain students in special education due to its multisensorial nature. Thus, learning environments must be designed in such a way that the attractive nature of virtual reality will not turn to be distractive. The laws of physics and spectrum of colors should strictly emulate those of the "physical world", in order not to further confuse the student. If a certain autistic child is sensitive to light or certain sounds, this child's cyberspace and equipment must be modified and constructed according to the child's special needs.

Another question we should raise concerns the *educational nature* of the cyberspatial learning environment. We must carefully examine if it is truly educational in essence, or just an attractive game for the child to play. Trotter (1991) raises the question of the *effectiveness* and the *educational nature* of some of the educational software packages that currently exist in the market. It is the special educator's duty to step forward and guide cyberspace architects in their work, so that the outcome will be appropriate for his/her students' needs and abilities. Although many will be quick to dismiss the teacher when introducing virtual reality, our earlier discussion demonstrates the significant role that teachers will play in future educational systems.

> "The new education must teach the individual how to *classify* and *reclassify* information, how to evaluate its veracity, how to change categories when necessary...how to teach oneself. Tomorrow's illiterate will not be the man who can't read; he will be the man who has not learned *how to learn*". (Toffler, 1970, p. 414).

These words of Herbert Gerjuoy's were cited more than 20 years ago by Alvin Toffler in his book "future shock". Has the educational system changed since? Indeed it has. The educational system is slowly turning to experiential learning. Yet schools still have a long way to go until we will keep up with Gerjuoy's vision of future education.

Sandra Helsel (1992) points out two important changes that virtual reality is likely to create in the educative process. The first is the shift from learning through *printed symbols* to learning via *simulations*. The impact of this change on students in special education will be even greater than in regular education, as many students have difficulty with printed symbols of age-appropriate texts. Hence, the exceptional student's accessibility to many sources of information currently available to his regular peers, is limited. The second change in the educative process is the change in curriculum materials from text-based to imagery and symbol based. How will those exceptional students who stumble over printed texts learn via symbols? How will exceptional students who find the abstract verbal communication difficult communicate in cyberspace? Will they find it easier to communicate their ideas and learning process via visual, tactile, auditory or olfactory means rather than the abstract verbal form of language? These questions are left to be answered by researchers in the field of education and psycholinguistics.

The first step, however, is to conceive the theoretical agenda for a virtual reality curriculum. Currently, such an agenda is not even framed, as Helsel (1992) correctly points out.

Another issue that needs to be addressed is the training and the composition of the groups that will construct the virtual learning environments. Benedikt (1991) called these people "Cyberspace architects". This group should include not only teachers and education specialists, but also artists, historians, graphic designers, neurologists, anthropologists and others.

The risks of using virtual reality in special education

Virtual reality holds great promise for education in general and special education in particular. However, we must first address some intrinsic aspects of experiences in cyberspace, that can pose risks to exceptional students.

First, what form will the student take in cyberspace? Will he\she take the form of a "prepackaged body form complete with voice, touch and behavior", as Stone (1991 p. 85) suggests? *External appearance* can be reconstructed in a relatively simple way. But what about the behavior, patterns of thought and personality? Let us assume that we can reconstruct a personality according to a menu that allows us to choose from a variety of "personality-options" or specific characteristics. The student, then, will be able to select, for instance, the personality of an historical dictator. Whenever the students will experience a situation in cyberspace while he is using his borrowed personality, the computer will offer him several alternatives. The computer will also mark the option that most likely would have been chosen by a person with that type of personality. The process that actors are going through when they play a role will be, in comparison, a poor imitation. Such an experience might be extremely harmful to students with personality and emotional problems. Even if the student *does* retain his own personality, what effect will the experiences in cyberspace have on him/her as a person? We must answer these questions *before* we let the student engage in a process that still has an unknown outcome.

If a physically disabled child will not be bound to his physical body in cyberspace anymore, why would he/she want to return to the *physical* reality, where mobility is a constant struggle? This question also pertains to regular students who will find the physical reality rather dull and disappointing after experiencing cyberspace.

Although the current technology and graphic resolution in cyberspace are still in their infancy, many predict that technology will evolve to the point where

> "Perception would change, and with it the sense of reality, of time, of life and death".
> (Stenger, p. 50).

Current flight simulators can quite accurately emulate real flight. However, we still *know* that we are in a simulator, because we remember that we entered through the door. But what if cyberspace could perfectly emulate our physical reality? How will we be able to differ between what our senses perceive within cyberspace, and what we sense and experience outside it? If we do not wish to shatter the already frail sense of reality of an autistic child or a severely mentally retarded student, we must think twice before we allow them to experience virtual reality.

Accidents or even death in cyberspace do not hamper the physical body of the child. The student would remain intact in the physical world. We all remember watching cartoon figures being run over by a car, and then inflating themselves back to life. If children may try sometimes to imitate animated two-dimensional figures, what will be the impact of 3-D simulations? We must bear in mind that this situation, which could hamper any person's judgment, might be especially detrimental to exceptional children. It can degrade their sense of self responsibility to their *physical* health. A possible solution was suggested by Heim (1991, p. 59): "Should causality underpin the cyber world so that an injury inflicted on the user's cyber body likewise somehow damages the user's physical body?" Maintaining the principle of causality as suggested by Heim will minimize the damages that can be caused by carelessness in the physical world.

Conclusion

Virtual reality holds a great promise for a revolution in the theory and practice of special education. Although the conceptual aspects and the technology of virtual reality are still in their infancy, their development is destined to dramatically change many aspects of our life, sociey and culture. Education is only one of the domains that can benefit greatly from this theoretical and technological evolvement. Virtual reality will open new opportunities for exceptional students to experience learning with all the senses that they have. Yet before we begin to change anything within the classroom, we must first develop the theoretical framework that is currently lacking. Changes in the curricular design and in teacher training programs will have to follow, and only finally we should try to implement our knowledge to the field of special education. The risks must be weighed against the gains, and not all the children will be able to safely learn through the cyberspatial medium.

One final thought -- it will take many years until the theoretical and technological developments will be able to produce the effects illustrated at the beginning of this article. Thus, it is reasonable to postulate that by the time Virtual Reality will be so advanced, medicine, genetic engineering and psychology will develop to the point that we will no longer need special education at all.

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Virtual Reality: Visualization in Three Dimensions

by
Hilary McLellan

We have arrived at the post-Columbus paradigm of exploration (Teixeira, 1992). In 1492 Columbus sailed the ocean blue...He traveled by ship, the technology of his day. Columbus went with his ships to the site of his exploration in person. Today, in the post-Columbus age, we send our technology ahead of us as we explore the universe. The technology of our day that makes this possible is virtual reality. With virtual reality, explorers can explore Mars via "virtual travel." Scientists can explore worlds that are too small for us to see, such as atoms and molecules, with virtual reality. Doctors can explore the human body, and even conduct "telepresence" surgery, without directly seeing or even touching the patient's body. Another example of virtual exploration is the virtual kitchen, developed by Mitsubishi in Japan, where consumers can select a kitchen with the appliances they want and, a short time later, the real kitchen is actually delivered and installed, based on their design choices in the virtual kitchen. Similar to this is wheelchair VR; people who are wheel-chair bound can field-tested building designs via virtual reality to determine if the design provides necessary access for those who are wheelchair-bound. Stock market analysts can explore and analyze financial data with the help of virtual reality (Teixeira, 1992). The virtual financial data consists of an ocean of icons representing different stocks, with rising and lowering rates. The behavior of the icons, such as blinking and spinning, represents different kinds of patterns. It is possible to move in close to look at information in detail. Ideally, this will permit Wall Street to represent much more information graphically in a way that is accessible to human analysts. Ultimately it will be possible to create and explore worlds that exist only in our imaginations and in virtual reality.

Virtual reality is a newly emerging tool for scientific visualization that makes possible multisensory, three-dimensional modeling of scientific data. A virtual reality system does more than make 3-D pictures: it gives the user the illusion of walking around in the 3-D scene. Virtual reality offers scientists the ability to work surrounded by images of molecules and other objects that they once had to use an electronic microscope to study. In addition to trying to immerse users into virtual worlds, scientists are using the virtual reality technology to augment the normal senses --- sight, touch, hearing, and even smell. At the MIT Media Lab, Margaret Minsky and other researchers are developing electronically simulated textures. With virtual reality, the emphasis is on visualization, with three-dimensional graphics, but the other senses are added to enhance what the scientist can "visualize." This includes haptic visualization, involving the sense of touch, and three-dimensional audio. Virtual smells are also envisioned. Researchers are working to extend the sensory range of what can be perceived in virtual reality to include electronically simulated textures, resistance, sound, and other forms of response. Robinett (1991) claims that the real power of immersive virtual reality technology "is that it can help you perceive the real world in ways that were previously impossible. To see the invisible, to travel at the speed of light, to shrink yourself into microscopic worlds."

There are two kinds of virtual reality. One type of virtual reality is an attempt to make a realistic representation of a world around us. Here the goal is to simulate a real surrounding. In the second type of virtual reality, the real reality is too complex to dealwith, so the goal is to create a simplified reality that facilitates insight and decision-making.

Robinett (1991) describes virtual reality as "a 3D video game you can enter by strapping something onto your face that fools your senses into perceiving an environment that surrounds you on all sides. The thing strapped to your face is called a Head-Mounted Display." The Head-Mounted Display contains a magnetic sensor whose precise position is tracked by a small box on a wall or ceiling nearby. Every time the person in the goggles moves her head, the tracker transmits this 'data' to the computer, which, in turn, changes the scene viewed in the goggles with only the slightest delay. When the user turns and looks to the left, or the right, the computer-generated scene shifts accordingly. This makes huge demands on computer memory and processing.

In virtual reality, the user is placed inside the image; the generated image is assigned properties which make it look and act real. The user enters the computational space rather than merely observing what's on a computer screen and interacting with it via keyboard or mouse. Instead of keyboard and mouse, there is now the Data Glove with electronic sensors and a head mount with stereoscopic goggles showing what would normally be viewed on the computer screen. Both the glove and the goggles are interfaced with the computer.

The Data Glove transmits and receives data so that the computer generated image responds to the movements of the user's hand, encased in the glove, as well as responding to the user's head movements, tracked by the Head-Mounted Display. A three dimensional model of this glove appears in the image shown in the goggles. This three dimensional model of the glove moves in correspondance with the user's hand movements in the real glove. The model of the glove provides an indicator of the user's position within the virtual space to orient the user. Pointing the glove moves the user through the virtual space. The user is not limited to horizontal movement in the virtual space; it is possible to move up to get a birds-eye view or to move down to get a closer look. And it is possible to move through 'virtual' walls and furniture.

Interactions with virtual environments are not constrained to only viewing. The user can interact with objects and spaces in VR. For example, the user can use tools to create new environments, to modify old ones, to fix errors, or to play. It is possible to interface with a virtual keyboard or to use voice commands to select options from a virtual screen menu. It is possible to manipulate virtual tools by making the appropriate hand gestures which are transmitted through the Data Glove to the computer, which directs the virtual glove to simulate those movements.

At this point, virtual reality technology is still fairly primitive: the motion of images are jerky and the computer-generated objects look more like cartoons than the real thing. The quality of the computer graphics in these systems is very poor by comparison with the photo-realism that is possible on the screens of high-resolution color monitors (Wheeler, 1991). This is because the vast quantities of data needed to portray a complex three dimensional image that must be revised every time the user's head moves.

Telerobotics

Virtual reality applications have been designed to direct and control the activities of robots at a distance. These robots may be used in space exploration or they may be used in dangerous settings where humans cannot safely go, for example nuclear power plants. A video camera in the robot's head permits the human operator to see what the robot sees, transformed into three dimensions with computer processing, which is viewed through the Head-Mounted Display. The hands of the telepresence robot allow the human operator to manipulate objects at the robot's location, by means of virtual reality (National Aeronautics and Space Administration, 1988). Telemanipulators are used to handle radioactive fuel in nuclear reactors. Teleoperated robots are beginning to be used to fight fires and defuse bombs. (p. 21)"

Telepresence Surgery

Richard Satava (1992), a military surgeon, is developing a telepresence surgery application to enhance laparoscopic surgery (removal of the gall bladder). Recent innovations in video technology have allowed direct viewing of internal body cavities such as the abdomen, through natural orifices or tiny incisions, instead of surgery involving large incisions and directly visualizing and touching the internal organs and tissues. This type of surgery is less invasive, resulting in less serious side effects, faster recovery, and lower insurance costs.

Traditionally, laparoscopic surgery involving noninvasive techniques has serious limitations in terms of the surgeon's ability to visualize the organs and lack of flexibility of the instrumentation. In the telepresence surgery system, the surgeon never touches the patient (after the preliminary incisions are made). Organs can be removed without directly touching or seeing them. With telepresence, there is a master-slave relationship between the instruments manipulated directly by the surgeon and the robotic instruments carrying out the surgery. Once this is fully developed, it will make it possible to conduct surgery at a distance: on the battle field, in space, or across the globe in a remote location.

Virtual Chemistry

At the University of North Carolina, Chapel Hill, a virtual reality system is used to help chemists explore the force-fields that bind molecules together or cause them to repel one another (Rheingold, 1990). In addition to three dimensional graphics that help chemists see the microscopic molecules at an enlarged scale, a force feedback arm simulates feedback pressure based on the force-fields. This helps scientists sense where to dock individual molecules into a combination of molecules, based on mutual attractions and repulsions. If two molecules repulse each other, they won't combine well, but if they attract, one can be docked to the other to form links in a chain of molecules. This research can help biochemists searching for targets on protein where they can attach drugs.

Virtual Planetary Travel

Virtual planetary travel is the application of telepresence involving unmanned rovers to planetary surface exploration (McGreevy, 1989). A planetary terrain visualization computer system provides dynamic interaction with planetary terrain data, for example data collected and relayed back to earth by Landsat or the Voyager Space Probe as well as unmanned space rovers and probes such as the Surveyor probe which made several landings on the moon. Currently this system is being applied to Mars and Earth. An example of virtual planetary travel, L.A.: The Movie, can be see on the videodisc (or videotape) State of the Art of Computer Animation (SIGGRAPH, 1987). An example of virtual planetary travel to Mars, Mars: The Movie, developed at the Jet Propulsion Laboratory in Pasadena, California, can be seen on Knowledge Navigator (Apple Computer, Inc., 1990).

Virtual Field Trips

There are many potential applications for virtual reality in education. Virtual reality or 'telepresence' field trips are already a part of the JASON Project (EDS, 1991). The JASON Project transports thousands of North American students via satellite to sites where scientists are uncovering historic discoveries and, through sophisticated data links, allows these students to become hands-on participants. At the interactive downlink sites for the JASON Project, three enormous video monitors give students a window on the action of scientific discovery. The focus of the research is JASON Jr., a 200-pound remotely operated vehicle (ROV) equipped with video cameras that can explore thousands of feet below the ocean's surface. Students at the downlink sites can talk to the scientists; they can also operate JASON Jr., directing its movement single-handedly, by means of a joystick and digital data link. Scientists are able to interact with students individually, as well as exchange questions and answers among the entire group.

Kellogg, Carroll, & Richards (1990) envision another potential educational application of virtual reality in their scenarion of a Visit to the Natural History Cyberspace Museum. This application does not yet exist, but it is nonetheless exciting:

Charles takes one of the empty seats associated with the exhibit in order to enter its habitat cyberspace. A monitor at the back of his seat will show curious onlookers what he is seeing. Activating the cyberspace, as he has done many times before, the goggles Charles is wearing opaque for a moment before he is suddenly swept into the virtual landscape of Archaeopteryx. As he orients and looks around, Charles sees one of the birds sitting on a low-hanging branch in a nearby tree. He approaches the tree and reaches out a virtual hand to touch the bird. As he makes contact, Charles's perception shifts as he takes on the perspective of the bird. As he makes contact, Charles's perception shifts as he takes on the perspective of the bird and surveys the landscape from his perch. Presently, he spots what he is looking for: he sees a coelurosaur on a distant ridge. He jumps down from the tree and runs toward the ridge. Confronting the beast, Charles again reaches out a virtual hand to touch it. His perception shifts again as he "becomes" the dinosaur. The bird stands nearby.

Virtual Entertainment

Virtual reality is having a big impact on entertainment, as evidenced by the Battle Tech game and the Dactyl Nightmare arcade game. Jonathon Waldern (1992), the British VR pioneer whose company W Industries produced Dactyl Nightmare, is developing a VR game where four users are linked together to serve as a team to fight the villains created by the computer. This system contains 100 rooms, each with a different scene. Players can choose which character and which characteristics they want, including not only appearance, but the voice they want, using a vocalizer to change voice characteristics to match the character. Waldern has also reported that the first VR theme park is in development. And a virtual reality game show will begin airing on British television in December 1992.

Architectural design

"Architectural walkthroughs" make it possible for architects and their clients to get a first-hand feel for the spaces they design, before the buildings are actually built. This enhances communication between the architect, who has highly developed visualization skills, and the client, whose visualization skills are not as highly developed. This application has been adapted to use by the differently abled, who can 'walkthrough' or 'wheelchair through' a building in the design stage and give the architect feedback on design features, such as the height of wall switches and kitchen cabinets.

Low cost VR Systems

Most professional applications of virtual reality require technology costing $50,000 and more. However, it is now possible to assemble hardware and software that make it possible to demonstrate virtual reality for about $200 (not counting the computer itself). Low cost virtual reality interfaces and applications are available for Macintosh and Amiga platforms. These applications do not have anywhere near the full power of the more expensive technology, but they do make it possible for you and your students to get a taste of the computer interfaces and applications that are on the horizon in the field of computer science. Mostly these low cost computer applications are limited to 3-D graphics programs, but there are some applications that include 3-D glasses or a Power Glove interface.

Amiga

1. Haitex 3-D System

Shawn Glisson of Haitex Resources, Inc., offers a very impressive system for about $200. This system includes 3-D software and electronic 3-D goggles. It operates on the Amiga with a standard mouse interface rather than a glove. This is the most impressive low-cost VR system I have seen. The graphics are excellent and the program provides a powerful and flexible design platform.

2. DIGI-Mice

The DIGI-Mice program from Tensor Productions is a software program, costing about $90.00, that makes it possible to interface the Power Glove (from Mattel Toys) with the Amiga computer for certain limited applications, such as a music program that comes together with the interface control program.

3. Virtual Reality Studio

Virtual Reality Studio, from Domark is a 3-D construction set software program for creating solid-modeled, animated "realities" and games, using the mouse as the interface device. With Virtual Reality Studio, it is possible to chain locations together to create worlds; for example, linking the rooms in a house. VRS has a built-in programming language that uses BASIC-like syntax and commands for animation and sound. Virtual Reality Studio has its limitations, including a limited graphics palette, but nonetheless it is a powerful program that puts a commercial- grade development system in the hands of consumers, giving a sense of what is possible with virtual reality. This program does not interface with any kind of either a Power Glove or Head Mounted Display device.

Macintosh

1. StereoMac 3-D

For the Macintosh, the StereoMac 3-D package is available from the 3-D TV Corporation for $195. This package includes: 1) an electronic 3-D stereovisor (Sega glasses); 2) a stereoscopic interface that can be used with the Macintosh Plus, SE, or II series computers; and 3) a diskette with several 3-D demos and source code in THINK C language, Version 4.0. The demos were developed by Juri Munkki of the Helsinki University of Technology in Finland. These demos include dynamic 3-D pictures of a spiral, a rotating Macintosh computer, and a maze, presented with a small 2-D map for navigation. You navigate the maze by holding down the button while moving the mouse.

2. Virtus Walkthrough 1.03

Another virtual reality program for the Macintosh is Virtus Walkthrough 1.03, a CAD (Computer-Aided Design) program for 3-D drawing and visualization that lets you "walk through" your ideas for spatial design. Virtus Walkthrough 1.03 contains an integrated set of modeling and presentation tools that make it possible for architects, engineers and other designers to create and communicate their ideas. This program has a user-friendly interface. It costs $259.

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Resources

Some resources for exploring virtual reality in greater depth include:

1. Rheingold, H. (1991). *Virtual reality*. New York: Summit Books. Excellent overview of the entire field of virtual reality for the nonspecialist; the history of its development and emerging trends. Howard Rheingold is a thoughtful writer who has been covering developments in computing and related fields for over a decade.

2. Krueger, M. (1991). *Artificial reality II*. Reading, MA: Addison-Wesley. An Excellent overview of one branch of virtual reality, artificial reality, by its inventory, Myron Krueger. Contains excellent photographs and diagrams

showing the full range of VR technologies as well as a good glossary of VR terms. A commercially produced artificial reality system, Mandala, is available for about $300.00 (plus the cost of hardware).

3. Helsel, S. (Ed.) (1990). Virtual reality: Theory, practice, and promise. Westport, CT: Meckler. Presents articles by several virtual reality researchers about their work. Sandra Kelsel is the editor of TheMultimedia Review, also published by Meckler, a quarterly journal that features articles about virtual reality and other multimedia.

4. Benedikt, M.L. (Ed.) (1991). *Cyberspace: The first steps.* Cambridge, MA: MIT Press. This book will be released October, 1991. It will contain articles by a wide range of authors, including the science fiction writer William Gibson (who coined the term cyberspace), and authors from Lucasfilm Ltd., Autodesk, IBM, Texas Instruments, and various universities.

5. McLellan, H. (1992) *Virtual reality: A selected bibliography.* Educational Technology Bibliography Series. Englewood Cliffs, NJ: Educational Technology Publications. Volume Six.

6. Media Magic (1990). Virtual Reality. [Videotape]. Media Magic, Nicasio, CA 94946. Tel. (415) 662-2426. $60.00. This video documents virtual reality technology and applications at VPL Research, the NASA Ames Research Laboratory, the University of North Carolina, and the Massachusetts Institute of Technology.

7. JASON Projects, EDS, 7171 Forest Lane, C001, Dallas, TX 75230. Tel. (214) 661-6516.

8. Houseman, Linda, Computer Science Department, University of North Carolina, Chapel Hill, NC 27599-3175. Reprints of articles about virtual reality at the University of North Carolina.

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Linking Bonds Between Art and Chemistry

by
Esther Waltz

One of the most important curricular area that provides a foundation for critical, logical, and creative thinking is chemistry. This statement is also true, if when repeated verbatim, the word 'art' is replaced with the word 'chemistry.'

Traditionally, chemistry has been used to teach scientific concepts that require a mathematical background sprinkled with logical and abstract thinking. The chemistry laboratory served as a focal point of activities and outcomes for the concept objectives. The traditional artists' laboratory, similar to the chemists' laboratory, too, allowed for logical and abstract thinking processes in generating tangible products. Creativity, although difficult to quantify, always infiltrated the dynamics in both chemistry and art experiences. In essence, many bonds that link those areas have always existed but remained segregated as subject areas.

During the past eight years the Community College of Allegheny County has been instrumental in enhancing the learning experiences of both science and non-science students with a non-traditional science course, Chemistry of Art. An essential specialty of the course is the constant interplay between a variety of concepts that link the bonds between the sciences and the field of art. Chemical principles such as atomic structure, electrovalent and covalent bonding, chemical reactions, and properties of light and color are interwoven with canvas board, paint brushes, microscopes, and cameras.

Non-science majors usually schedule a non-laboratory science elective, tend to avoid chemistry, and may not feel comfortable with the level of mathematics required to experience success in a traditional chemistry course. In the Chemistry of Art course minimal mathematics is used in presentations. Instead, significant emphasis is placed on making the art of non-science oriented people aware that they are indeed chemists in their fields. At the same time, the science oriented people realize their artistic potential. The linking bonds in this course help the "Chemartists" dismiss stereotyping of either a chemist or an artist.

Chemistry of Art offers hands-on experiences that allow for imaging, producing, and linking concepts of art and chemistry.

MAJOR CONCEPTS

Major concepts include:

A. The language of chemistry

- Art of the periodic table
- Atoms and elements
- Atomic structure
- Electronic configuration
- Bonding
- Nomenclature
- Chemical reactions
- Balancing equations

B. Chemistry of textiles
- Natural fibers
- Synthetic fibers
- Acids and bases

C. Paint chemistry
- Ingredients
- Health related hazards
- Solutions

D. Chemistry of photography
- Electromagnetic spectrum
- Properties of light

E. Physics and chemistry of color
- Light primaries
- Pigment primaries

F. Leonardo da Vinci
- The artist
- The scientist

LABORATORY

Laboratory experiences include working in the chemistry and photography/art laboratories.

A. Experiments performed primarily in the chemistry lab include:
- Safety as a chemist
- Measurements
- Flame tests
- Pigment preparation
- Chemical reactions
- Glass sculpture
- Solvent effect on fibers
- Ph of everyday chemicals
- Crystals on slides

B. Experiments performed primarily in the photography/art labs include:
- Safety as an artist
- Painting the "original"
- Mixing light colors
- Mixing pigment colors
- Photography with a microscope
- Photography with a 35 mm camera
- The camera as an instrument of science
- The camera as an instrument of art
- Developing film
- Printing the negative

This course was originally intended to attract the art students and to fulfill a required science elective. However, students from a variety of areas including art, business, education, and science have been successful in completing the course. For those students who are somewhat unsure of a specific major, Chemistry of Art has offered the opportunity to experience areas that may be somewhat foreign to them. In many cases students have pursued a new direction of studies after completion of the course. Art oriented students have registered for a traditional chemistry or science course; science oriented students have continued with an art or photography course. Over the years Chemistry of Art has remained a non-traditional course that continues to enhance the humanities in science and promote the science of art.

Those who have taken this course perhaps appreciate more fully the bonds and commonalities existing between the science and arts--where creativity is common to both, and where hands-on experience, visualization, and critical thinking can become one.

Additional Reading:
The Chemistry of Art: A Sequel. (April, 1981), Journal of Chemical Education

Visualizing the Complexities of Instruction: The CMT Paradigm

by
Robert C. Branch

This is a brief essay about the relationship between instruction and instructional design. It is intended to promote discussion and build consensus among practicing instructional technologists as well as those new to the field of instructional design. The purpose is to illustrate instruction that involves multiple complex processes, and to explain how the practice of instructional design responds to those complexities of instruction. There is a need to understand the subtle differences between current definitions of learning, instruction and technology, and how their important relationships affect the achievement of students. These views are offered from a systems theory approach with instructional design as the perspective.

The aim of instruction is to assist the individual as learner. Achieving such an aim is complex because instruction occurs in an environment where each participating entity is within itself complex. The Learner, the Content, the Media, the Teacher Function, and the Context within which learning is to occur interact during a period of time to form an instructional episode (CMT paradigm). What are then formed are multiple two-way relationships between: the learner and the content, the learner and the media, the learner and the teacher, the learner and the context, the content and the media, the content and the teacher, the content and the context, the media and the teacher, the media and the context, and the teacher and some context, each occurring along some dimension of time (Figure1). Considering these interrelationships during the instructional episode causes the complexity of the learning process to increase exponentially. However, it is within the CMT paradigm that all instruction occurs (Figure 2).

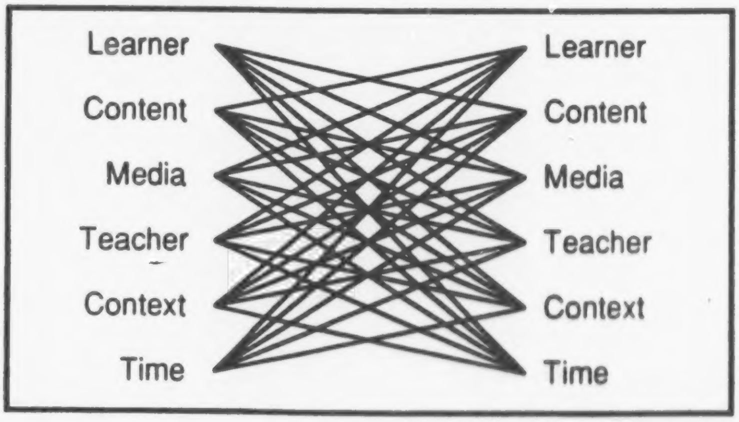

Figure 1. The multiple two-way relationships which compose the instructional episode.

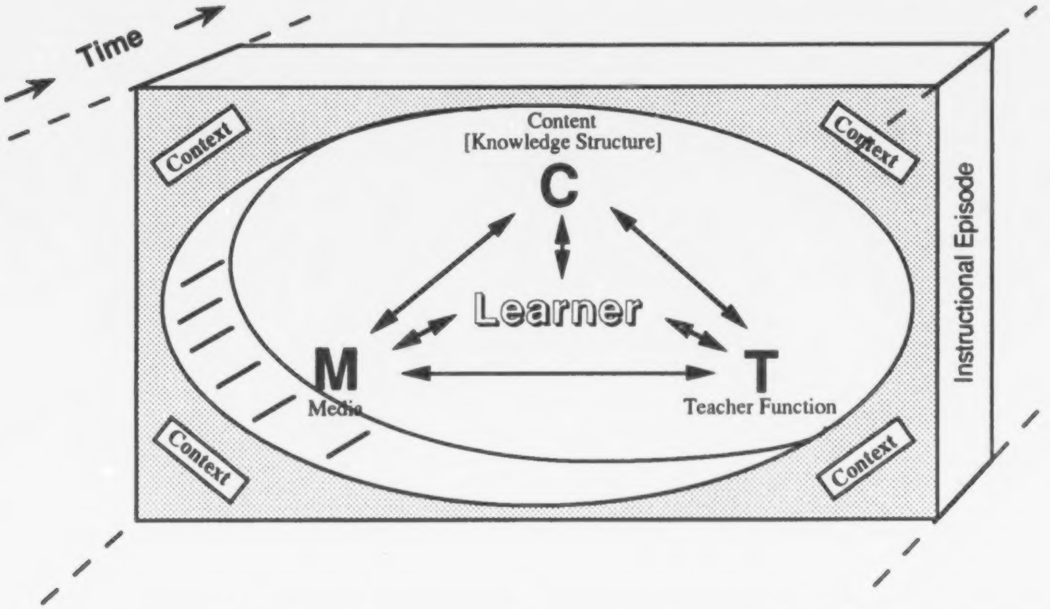

Figure 2. The complex environment in which learning occurs (CMT Paradigm).

The Learner

The learner is the focus of instruction. However, learners bring multiple expectations, goals and diverse values to the classroom that affect how they interact during the instructional episode and, ultimately, how they learn. It is important that instruction accounts for the individual differences within the learner audience. The more a teacher knows about the history, language, values, nonverbal behavior, and lifestyles of a group of people, the better she or he can incorporate such knowledge into instruction.

Education as a societal aim has the expectancy of certain outcomes from the educational system, such as production of a responsible, contributing citizen. Even in the business environment where the learner is often less the focus of instruction than are the business goals which have made the instruction necessary, the rules of corporate training and education need to be revised. "Line workers [have] to actually understand their work and their equipment" (Wiggenhorn, 1990, p.71).

Instruction should be treated as the vehicle that enables the learner to construct, or reconstruct, personal understandings, values, and beliefs. To understand the complexity of the learner is to understand the physical, emotional, social and mental development of people, as well as the effect of intelligence, cognitive styles, motivation, cultural norms, creativity, socioeconomic status and gender of the learning process.

The Content

Among the factors that influence the design and development of instruction is the structure of the content information. Content as a body of knowledge may be static or dynamic, but it is not a collection of unorganized facts existing in relative isolation one from the other (West, Fensham & Gerrad, 1985). Rather there are certain orderly structures inherent within subject matter knowledge (Reigeluth, Merrill & Bunderson, 1978; Wilson, 1985). Information is not discrete, isolated bits of knowledge, but, exists within an organized structure (Eylon & Reif, 1984).

Such structures reflect the interconnections or interrelationships among the facts, concepts, and principles that make up subject matter knowledge (Anderson, 1983). Representations of information and interrelationships among information can be called knowledge structures (Hannum, 1988).

When students learn subject matter knowledge, they learn both the specific content (the facts, concepts, and principles) and the structure that interrelates this content (Champagne, Gunstone, & Klopfer, 1985; Champagne, Klopfer, Desena & Squires, 1981; Geeslin & Shavelson, 1975; Naveh-Benjamin, McKeachie, Lin & Tucker, 1986; West & Pines, 1985) including cultural and personal norms perspective. The most prominent types of information relationships found in most knowledge structures are: attribute, categorical, classification, component parts, dimension, elaboration, goal, hierarchical, kinds, matrix, prerequisite, procedural, rule, skills, and type.

Because there is an orderliness or structure within subject matter knowledge, instructional technologists can design instructional episodes that adapt to the underlying structure. An understanding of the subject matter structure will assist instructional designers in organizing and sequencing instructional strategies. The same understanding of a specific knowledge structure should be communicated to learners to assist them in translating information from the knowledge structure of the content area to their own cognitive structure. For instructional episodes to achieve the desired effects, content information should be presented concurrently with its knowledge structure.

Recent evidence suggests another major facet of the complexity of content as a knowledge structure is centered around the issue of learner control. The learner should exercise some degree of control over the instructional process. Learner control can be described as the learner's judgements as to what should occur during instruction and why. Control by the learner is important for the understanding and assimilation of the content.

Media

Media is most often perceived as bright screens and fancy input/output devices, and is often perceived as synonymous with technology. The mere mention of media or technology evokes mental images of machines for which one is likely to immediately request assistance from the building's AV specialist. Some educators are comfortable with technological products and are adept at utilizing innovative technologies as educational media, and realize the concept of technology extends beyond the notion of hardware. The use of media in instruction should be determined based on the specific instructional objectives.

The role of instructional media is to provide communication cues that stimulate interest, motivate, illustrate ideas, provide concrete experiences, and direct attention. However, many communication cues found in media can be so internalized, that the effect of such cues on those with different backgrounds from one's own is often unrecognized. If the manner in which content information presented is biased towards a particular group, the risk is a reduced effectiveness in reaching all students. Instructional technologists should be taught strategies for ensuring cultural pluralism in instruction through the selection process of instructional media. Media which is related to the personal experiences of the learner will assist in building upon her or his prior knowledge as well as promote multiculturalism, while media that is foreign to the experiences of a student or offensive to the values of a student tends to inhibit learning.

The Teacher Function

Good instruction is goal oriented with a specific purpose, therefore, the control over what is achieved is implied. Thus, instructional factors are within the realm of the teacher's manipulation.

Teachers and instructional designers arrange the content information around an organizing idea, determine appropriateness of available resources, and make judgements about the people involved.

The more a teacher knows about the history and lifestyles of the learner, the better a teacher can instruct. Generally, the teacher functions as decision maker regarding what will be taught. The teacher is often the primary information source unless the teacher functions solely as a facilitator of information. As facilitator, the teacher arranges the classroom interaction to motivate the learner and to direct the learner to different ways of knowing. Teachers guide learner actions, monitor progress, and manage the implementation of instruction. In most of the societies of the United States the teacher is also expected to function as disciplinarian, which ought not be the case.

The complexity of the teacher function increases when the teacher is considered as facilitator rather than the sole source of information. More cynical perceptions of the teacher are as a highly paid baby sitter, or a poorly trained police officer or social worker. Even the Utopian teacher role requires increasing individualization, group arrangements, societal norms, and information selection.

Context

Instruction is a form of education. Education, according to Frick (1991), is bound in time and space, and occurs in settings that may include persons other than teachers and students as well as places and things. It is the context which directly or indirectly influences the decisions that are made about instructional episodes. For example, decisions about state budgets tend to effect resource management to the extent that instructional strategies are compromised. Instruction does not occur in a vacuum and failing to be aware of that leads to a dangerous misunderstanding of instruction, as well as the meaning of instructional technology. The context within which instruction occurs is acknowledged as an entity that is comprised of conditions which instructional technologists are able to manipulate and those which are beyond the realm of manipulation.

Time

Time as a variable within the instructional episode is also complex because of its infinite, yet discrete, nature. Beginning and ending points, and precise units are arbitrarily set for the benefit of arranging nearly all human activities. Time is the controlling variable of most formal education environments. Further, time as the ever present variable, must be addressed due to its influence on every other variable within the instructional process.

While a comprehensive discussion of the concept of time is beyond the scope of this essay, it is important to note time's relevance to the instructional episode. The reality of instructional contexts is that formal educational environments are designed to promote learning, however, learning will have occurred in individuals prior to engaging in the activities set forth as part of instructional episodes and individuals will continue to learn after engaging in the activities of the instructional episode. Instruction may begin and end, but learning occurs all the time.

The issue here is relative to the interaction which occurs during the instructional episode. Learner achievement of prespecified outcomes depends on the chosen instructional strategy for a predetermined amount of time, such as during class period or field experience. An instructional strategy may vary in effectiveness depending on the allotted time. Moreover, the quality of an instructional activity is affected by the amount of time that can be devoted to it. Further, the abilities of individual learners directly influence the amount of time required to achieve specific learning outcomes. Understanding how time affects learner achievement is important because time is one of the few resources that can be directly manipulated by the teacher and the learner.

Instructional Design

Instructional design is the planning phase of the instructional creation process. An instructional design is descriptive. It presents natural or existing interrelationships that constitute a content area. Instructional design is also prescriptive. It recommends organization, or reorganization, of information or sequence of events based on known learner characteristics, content as a knowledge structure, specific media and their attributes, salient features of the teacher function, the educational context, and the time available.

Instructional design is informed by general systems theory, learning theory, instructional theory and communications theory. General systems theory provides a framework from which the relationship between educational goal, performance objectives, instructional strategies and evaluation emerge. The feedback loop that is requisite to general systems theory allows the designer to respond to individual learner characteristics for specified content information delivered by a teacher utilizing appropriate media. Learning theory provides the background on how individuals acquire, store, retrieve, apply and synthesize information. Learning theory provides the descriptive aspects of instructional design while instructional theory determines the prescriptive strategies in order to meet the conditions described in learning theory. Communication theory describes what happens to a message sent from a source to a receiver. It is communication theory on which many of the principles guiding the practice of message design are based.

Instructional Design is a process which systematically addresses the aspects associated with the complexity of the variables within the CMT paradigm, by organizing their interactions in meaningful ways. Optimal sequences of learning activities that maximize available resources are arranged within the design phase. The product of the design phase is a detailed plan that defines the conditions of learning, describes relevant instructional relationships, and prescribes strategies and procedures for the development of instructional episodes. The resultant instructional design plan also identifies appropriate evaluation criteria for assessing potential strengths and weaknesses of the planned instructional episode. A generic model of the fundamental instructional design process is presented in Figure 3.

Common instructional design practices include:

1. Recommend alternative to instruction.
2 Translate conceptual models into prescription for practice.
3. Perform needs and learner analyses.
4. Determine scope, purpose and goals of instruction.
5. Select appropriate instructional strategies.
6. Generate and sequence objectives.
7. Construct assessment procedures.
8. Generate instructional analyses such as task, job, content, procedural and learning hierarchies.
9. Construct formative and summative evaluation plans.
10. Draft instructional blueprints.
11. Consult subject matter experts.

Conclusion

Creating or improving instruction is complex. The practice of instructional design focuses on the use of organization, strategies and tactics that are supported by principles upon which instructional improvements can be structured. Instructional strategies are the general points of view and line of action that one adopts in order to choose the instructional methods; or a set of decisions that result in a plan, methods, or series of activities aimed at obtaining a specific goal.

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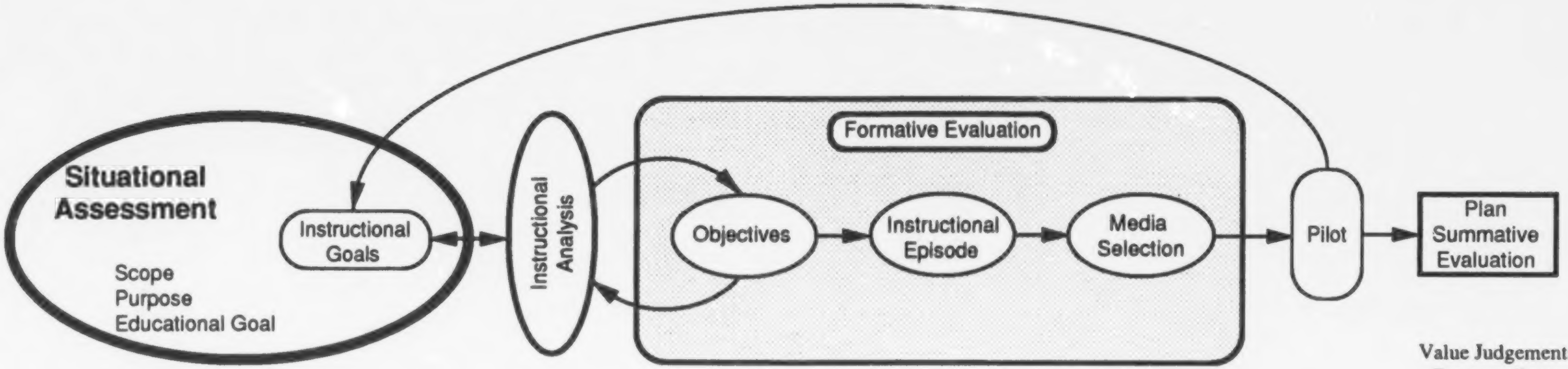
Instructional Design Process



Situational Assessment

Instructional Goals

Scope
Purpose
Educational Goal

Instructional Analysis

Formative Evaluation

Objectives

Instructional Episode

Media Selection

Pilot

Plan Summative Evaluation

Team concept
  Instructional Designer
  Instructional Developer
  Subject Matter Expert (SME)
  Management (Mgt)
Scope of performance assessment
Purpose of instruction
Educational goal

Task
Content
Job
Learner
Skill
Intellectual
Procedural

Statements of:
  Conditions
  Performance
  Criteria
Matching test items

Sequence of events
  Pre-instructional
  Informational
  Learner participation
  Assessment
  Closure

Relevance
Availability
Production Cost

Goals as the Test
Actual Audience
Expert Review
Go/No go Decision

Value Judgements
Program Costs
Management

Instructional Goals:
Learning domain specific

Formative Evaluation Plan

Objectives as the test
Based on:
  Learning theories
  Instructional theoies
  Data collection procedures
  Data analysis procedures
  Communication skills
  Management issues

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Figure 3. Generic model of the fundamental instructional design process.

Instructional strategies describe a general approach to instruction by prescribing how to organize, sequence or present information within the instructional environment.

Teachers often express a reluctance toward the use of instructional design models out of fear that the systems approach will restrict creativity (Branch, Darwazeh & El-Hindi, 1991). However, a systems approach to developing instruction promotes creativity because of the dynamic attributes of the systems process. Systematically designed instruction is a process which allows the teacher to establish clear relationships between instructional strategies and the predetermined learner outcomes.

As a field we are still at the stage where we find ourselves defining terms, terms which perhaps should already enjoy consensus. This essay is an attempt to create some degree of closure on important concepts and practices within the practice of instructional design. This should result in instructional designers devoting more attention to the issues impacting the field. In addition to being more focused, such consensus building should also increase the potential for instructional designers to successfully promote the practices within the domains of instructional design among the greater educational community.

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Architectural Images Through the Dual Lens of Picture Books and Creative Dramatics

by

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Pamela Scheurer
Mary E. Shorey

INTRODUCTION

Introducing architectural concepts to children is a relatively new area of the curriculum for schools, whether they be elementary schools or high schools. It is true that school children have looked at photographs of the Parthenon in art or history classes; perhaps they have learned how to differentiate the forms of the classic Greek columns—Doric, Ionic, and Corinthian. In most cases the knowledge that was gained was isolated from experience. The idea of architecture as a meaningful and vitally important part of the student's environment was not present.

Curriculum Integration of Architecture Education

What is new today is the integration of architecture education into history, mathematics, and other subject areas. Several curriculum projects dealing with architecture and design or architecture and the environment were developed in the 1980's with the help of professional societies. The American Institute of Architects has been involved in elementary and secondary education since 1966, "working nationwide to help clarify issues and develop methods and materials for raising public consciousness." (Sandler, 1989, p. 13). Their program, "Learning by Design," provides resources to assist teachers and students in gaining a better understanding of the factors that shape environments. Students develop an awareness and appreciation of the environment and skill in visual thinking and decision making, as well as mastery of program content (Sandler, 1989).

Programs and workshops ("Teach the Teachers") sponsored by the American Institute of Architects, have been conducted in Missouri, Kansas, Minnesota, Iowa, North Carolina, and other states. These "familiarize teachers with basic concepts about the Built Environment" (Graves and Graves, 1989). In Illinois, Project Archi-Teacher was designed to assist teachers in implementing design education in the curriculum. Olsen speaks of the enthusiasm of teachers in the workshops and the reluctance she sometimes observed to using the workshop activities and resources in the classroom. "Why is it that elementary teachers are so reluctant to teach design concepts, although few stop to worry that they are not astronomers before they introduce students to the sun and planets?" (Olsen, 1989, p. 23).

This interest in the appropriateness of architecture as a subject for school study is not limited to the United States but is echoed in other countries such as Great Britain and Australia. A British project, "Learning to See," studied work in the schools which, based on environmental experience, was intended to develop: aesthetic and design awareness; a feeling response to place; discriminatory and critical skills; and design ability which was concerned with shaping the environment and

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dealing with change (Adams, 1989, p. 183).

A Framework for Architecture Education

A useful framework for thinking about architecture is found in Willey's discussion of architectural design education.

> Architecture can be perceived as comprising two distinct design traditions; building as concept and building as construction. On the one hand the building is seen as the realisation of a set of ideas about the philosophy of beauty, symbology and the nature of space, human interaction and place. On the other the building is an assembly of materials that are jointed, finished and positioned to protect and promote human activity. (Willey, 1989, p. 15)

An introduction to these concepts can be made to elementary school children while older students would deal with them in greater detail and complexity.

While it is desirable to have an extended period of time to consider architecture and its links to environment and culture, it is also possible to provide an effective experience in a shorter space of time. This paper will discuss the use of picture books and creative dramatics to encourage children to think about architecture. In just a few hours, a fourth grade class considered the destruction and rebuilding of a cathedral, examining picture books, postulating ideas about construction, and engaging in creative dramatics to represent their ideas

PICTURE BOOKS

Some picture books deal directly with architecture— with drawing plans, examining the techniques of building, looking at the materials which go into the building— these are aspects of building as construction. The other aspect, building as concept, considers the attractiveness or aesthetics of the building, and the interaction with people, space, and place (Willey, 1989).

Building As Concept

Many of the children's books reviewed deal with the aspect of concept in the manner in which Frank Lloyd Wright defined architecture. In his 1939 book, *An Organic Architecture*, Wright stated,

> I know that architecture is life, or at least it is life itself taking form and therefore it is the truest record of life as it was lived in the world yesterday, as it is lived today or ever will be lived.... Architecture is that living creative Spirit which from generation to generation, from age to age, proceeds, persists, creates, according to the nature of man, and his circumstances as they change. (quoted in Maddex, 1985, "Opening")

Form and Function and Culture

An excellent example of this record of life is Philip Isaacson's 1988 *Round Buildings, Square Buildings, and Buildings That Wiggle Like A Fish*. He describes through his photographs and his writing how various elements create the mood and character, personality and harmony found in buildings. He shows us how function is often the same, but is represented quite differently by numerous forms. Isaacson has compiled a visual collection of architectural styles which span the ages and the world.

Style can also be examined in *The House I Live In*. This is an introduction to types of dwellings in various geographical regions of the United States. The author explains why people built houses where they did and in the style in which they did: adobe homes in New

Mexico, stone homes in Pennsylvania, Victorian homes, log cabins, trailers, and houseboats. A history of the dwelling, the reason for the design, and an update on the buildings' changes make this book a good inspiration for children to take a closer look at the houses in which they live.

Both of these books could be used as springboards when exploring architectural style. Why are certain styles popular at certain times? Why do styles vary from place to place? Children can produce a photographic record of their homes and prominent buildings in the community to make a classroom book describing various local architectural styles. These images will help children understand the reasons for the structures: the form, the function, the placement within their town or city.

By being sensitized to style and form and function of structure, children may more easily see that who we are as a culture is mirrored in our surroundings. Through picture books on architecture, children can see representations of their cultures and their world. Children can hypothesize, examine, and inquire about the logic behind the buildings. Why is that building so tall? Why is it so ornate? What has kept that building from falling? What do buildings have in common? Who might live in this building?

Many cultures can be explored through architecture. *Houses and Homes* is a photographic picture book of dwellings and people who inhabit those dwellings throughout the world. With a minimum of words the author describes the size of houses, the materials of which some houses are made, and the ingredient needed to make a house a home: love. The index of *Houses and Homes* catalogs the photographs found on each page, designates the country in which the photo was taken and presents a one sentence description of the scene. The map on the last page documents the country in which each photo was taken.

Another book which looks at the various cultures through the style and structure of houses is *This Is My House*. This 1992 publication presents an illustration of a house on each page, lists the country in which the house is located, and gives several sentences about materials in the house or the location of the house. What is unique about this book is that the sentence "This is my house" is repeated on each page in English and in the language of the country whose dwelling is being featured on that page.

Style and Structure

Children can discover changes in buildings closer to home in books like *Since 1920* and *New Providence: A Changing Cityscape*. These books present pictorial histories of a neighborhood and a city. They help children understand how buildings reflect the ideas, values, and events of the times during which they were built, how their surroundings and, subsequently, the function of these buildings change or stay the same. *Since 1920* shows the evolution of a family's home and neighborhood from a bungalow in the country to a used-furniture store in the city. The neighborhood gradually develops through the 1940's, the city begins to reach into the neighborhood in the 1950's, the area becomes run down in the 1960's and 1970's, and urban renewal takes place in the 1980's. Children can see the progression from open field to crowded neighborhood and can look for changes in the structure and function of the buildings. Children can examine and question those changes. What factors in our society influence changes? How are these changes for the better? How are they not for the better?

New Providence: A Changing Cityscape depicts an imaginary city from 1910 to 1987 and describes how the buildings serve various functions with the demand of the times. The authors and illustrator have compiled visual images of buildings found throughout the United States to create this city. Perhaps children could become involved in designing a city of their own and describing the importance of each of their buildings.

Victoria House is a story about a deserted Victorian style house which is given life and becomes a home again when it is moved to the city, repaired, and refurbished. Perhaps this book could be used in a lesson in preservation and renewal or even on recycling.

Building As Construction

The other aspect of architecture, that of building as construction, is presented in a variety of books. Often books featuring construction are used as the stepping stones to books that deal with the concept of architecture or with books that incorporate aspects of construction and concept within the same book.

How Things Were Built is an illustrated history of notable structures of the ancient and modern world. It is a catalog of illustrations, architectural diagrams, and terminology. Each double page is filled with the various stages of construction of a structure and the description of the process. Several inserts appear on the page with additional information on a particular detail of the structure. For example, on the pages depicting the Theater at Epidamus, two inserts, one on Greek Engineers and the other on Tools are featured along with information about the plan, the stage, and the construction. Terms such as the "theatron," "orchestra," "skene," and "acoustics" are highlighted. The definitions of those terms are found in the glossary at the end of the book.

Grand Constructions is another book which focuses on the historical progression of architecture. Information is presented in a large format with finely detailed illustrations of the finished structures. This would be a good companion book to use with *How Things Were Built. Grand Constructions* emphasizes the background information about the structures while *How Things Were Built* focuses on the detail of the act of construction.

Houses of Hide and Earth, one of a series on Native dwellings by Bonnie Shemie is a straightforward account of the shelters, the tipi and the earthlodge, made by the Plains Indians. Materials for the shelters are described, the symbolism of the shapes of the shelters is explained, and black and white line drawings showing the process of putting up a tipi and building an earthlodge are presented. Diagrams show us the various parts of the shelters and placement of the materials used. Several colored pictorial spreads are interspersed throughout the book, but the major part of the text and illustrations concentrates on the construction of the shelters.

Gail Gibbons is an author/illustrator known for her basic informational books for children. Her *Up Goes the Skyscraper* is a step by step account of the construction of a skyscraper from the initial plan to the finished structure. Throughout the book, she highlights words which are important in the process and defines the terms through illustration. We see the "city inspector" and the "building permit," the "pile drivers" and "anchor bolts," etc. Terms such as "wind load" and "columns" are explained in the text as well as through the illustration.

The aspect of construction can be found in books that don't necessarily purport to be books on architecture. To interest young children in thinking about architecture, familiar stories can be used. Some critical thinking and problem solving might go along with finding out why the three little pigs had such trouble in keeping their houses together. Why did one building remain while the others were destroyed? What might the children try for building materials?

The House That Jack Built is a classic cumulative tale that many children are introduced to along with other Mother Goose rhymes. A traditional version could be compared to architect Robert A. M. Stern's 1991 rendition, *The House That Bob Built*. In this interpretation, the author visually introduces children to the layout of the house as well as to ideas about light and space in each room of his extraordinary house which he has built by the sea. Could the children write their own stories about their houses?

Imaginative Participation

Introducing children to style and detail through the alphabet is also a way to encourage children to look more closely at what they see. *Archabet* is a collection of photographs that invites the reader to discover the letter shapes within the visual. Although this book contains fairly sophisticated quotes about architecture by prominent individuals (authors, statesmen, architects), the photographs can easily be the focus for discovery for young children. After finding the letter shapes in the photographs, children might enjoy a walk around the neighborhood searching for letters hidden in buildings which are familiar to them.

Another alphabet book, *Architects Make Zigzags: Looking at Architecture* presents architectural terminology, a brief description, and a line drawing of an example of the term for each letter of the alphabet. For example, "R" is for roof, "S" is for style, "T" is for tower, etc.

Many books that deal with the aspect of construction present detailed illustrations that invite imaginative participation from the viewer. The author of *The Truth About Castles* explains castle architectural terminology, design, purpose, and uses of castles in detailed full page visual spreads. The various areas within the castle are described: motte and tower, the keep, the inner courtyard, etc. An additional storyline carried on by the characters within the illustrations accompanies the explanatory text. The added detail allows the reader to search through and examine all parts of the illustration.

This book is a good example of looking from the inside out to understand the way something functions. Author-illustrator David Macaulay addresses this in his 1988 Horn Book Award speech. He says,

> In studying architecture, I learned to see things from the inside out. I learned that the form, the look, of a building, a product, or a natural object develops in response to one or more functions. I learned that there is usually some logical connection between what something does and the way it looks and that understanding the way something looks can often help us understand what it does. (Macaulay, 1990, p. 25)

Structures from the Inside Out

Macaulay's book, *Cathedral: The Story of Its Construction* illustrates his belief. Detailed diagrams of the inside of a cathedral are interspersed throughout the book as the story of a town's dedication to build their cathedral is told. Macaulay's commentary presents the terminology of cathedral building, introducing children to flying buttresses, gargoyles, vaults, and keystones in a narrative which chronicles the construction.

Another book which examines the building of cathedrals is *The Cathedral Builders*, one in a series of books on Peoples of the Past. This book describes the construction of Gothic cathedrals and also the significance they had in the lives of those who built them. Detailed, colored maps and illustrations depict the locations and construction stages of these structures. Parts of the cathedrals are featured as well as information on those who worked at the sites. Both this book and Macaulay's feature a glossary of terms for the reader.

The 1992 publication *Stephen Biesty's Incredible Cross-Sections* is a compilation of cut-away illustrations of various buildings and machines. This book exemplifies the idea of looking from the inside out. The buildings and machines are dissected to reveal their hidden parts. An ocean liner, a car factory, an opera house, a coal mine, a castle, and a cathedral are a few of the structures that are featured. In examining the Cathedral pages, children can find out in detail about twenty-six different parts of the structure: the nave, the maze, the crypt, etc. Additional information about a specific cathedral and the people who worked on the construction also is presented. Pertinent statistics such as length, volume, etc. as well as scale, are given for the other various buildings and machines.

There is a variety of activities which can be designed around these books. Many of them or just a few can be used to develop a theme. For example, how could a teacher use Macaulay's *Cathedral* in a classroom, incorporating illustrations to understand form and function? How can several books on cathedrals and life during the middle ages invite imaginative participation from students? How can students come to understand the times and cultures of others? How can a teacher provide an experience to extend the visual? Using five books: *Cathedral: The Story of Its Construction*, *The Cathedral Builders*, *The Luttrell Village: Country Life in the Middle Ages*, *Stephen Biesty's Incredible Cross-Sections*, and *What It Feels Like to Be a Building*, a fourth grade class in Columbus, Ohio shows us how these questions can be answered.

DRAMATICS

Phase One: Building the Dramatic World

A group of fourth grade students participated in drama activities, centered on rebuilding a Gothic cathedral, which enabled them to understand the construction and conceptual aspects of architecture in more vivid ways. The teacher began by saying, "The next time I speak to you I will speak in role."

And she continued by saying, "As you know, we have had a terrible disaster and many buildings in our town have been destroyed." After discussing the disaster the teacher showed the children a picture of a cathedral and continued, "The symbol of our hope, our cathedral, has been completely destroyed." This was followed by questions and discussion that emphasized the importance of the cathedral in their lives.

The teacher added that the architects had guaranteed that the cathedral would not be destroyed by such a storm as they had experienced. She continued, "What then went wrong?" When the students were asked if they were willing to find out what had happened to their cathedral and rebuild it, all hands were enthusiastically raised.

When the drama began, many of the students had no idea what a cathedral was. Some of them, drawing on what they knew, thought it was a castle. The initial drama activity then helped the students build their concept of cathedrals. Like the original cathedral, it became for them a place that bound them together as a community and served as a symbol of their hope.

Aspects of construction, including form and function, were considered when they looked at the picture of their cathedral and when they discussed how it functioned in their lives through such rituals as baptism and marriage. The aspect of construction was deepened in the second phase of the drama as the students gathered research and postulated theories as to why the cathedral collapsed.

Phase Two: Using Picture Books

At this point the teacher sent the students, in their roles as villagers, down into the archives of the cathedral to investigate. The students took clipboards, paper, and pencils and went out into various sections of the drama room where books and pictures dealing with cathedrals had been placed. These books included: *Cathedral: The Story of Its Construction* by David Macaulay; *The Cathedral Builders* by

Marie-Pierre Perdrizet; and *The Luttrell Village: Country Life in the Middle Ages* by Sheila Sancha. Students worked in groups and pairs and looked at the pictures, hypothesizing reasons for the collapse of the cathedral. Some wrote facts and ideas, some drew pictures, some gathered in groups to compare and contrast what they had found, and others discussed their ideas with the teacher.

After spending twenty minutes on this activity, the students were called to a meeting to share what they had found. Every child had her/his own theory about the disaster. Some thought that the builders had used faulty materials, others thought that buttresses had not been used in the final construction, and one boy, after looking at the wooden framework illustrated in his picture, said, "I think it was termites."

This activity focused on the construction aspects of cathedral building. By being in role as villagers the students had a reason to look carefully and critically at various illustrations and pictures of cathedrals. They were adding to their understanding of various aspects of architecture by creating a dramatic context for looking at and responding to these pictures.

Phase Three: What It Feels Like to Be a Building

At this point in the drama the teacher said she had found a sealed box that contained some mysterious pictures. She opened the box and took out several illustrations and passed them to the children saying, "What could this mean? I don't understand!" The pictures were from the book *What It Feels Like to Be a Building* by Forrest Wilson. They show various aspects of cathedrals such as columns, arches, and buttresses using human or animal bodies to represent the shapes. The children chose four of these illustrations and, working in small groups, created an improvisational dream which responded to what they had seen.

One group used the picture of a buttress and acted out what happens when buttresses are removed. Members of this group enjoyed falling dramatically to the ground. Another group used a picture of the Gothic arches in front of a cathedral. They then positioned themselves on chairs with their arms extended to represent the arches. As they moved into position they chanted:

> We must build a cathedral.
> We must build a cathedral.
> Let's build a cathedral.
> This time it will stay.
> This time it will stay.

By physically involving the students, this activity intensified their understanding of the construction aspects of cathedrals. They became the building and felt what the building felt such as the stress on the arches and the support of the buttresses.

Phase Four: The Ritual

At the end of the drama the children formed a circle and the teacher narrated that they would begin to rebuild their cathedral by repairing the stained glass window. This was to become a symbol of hope and help them face the task of rebuilding the rest of their cathedral. Listening to a recording of a medieval chant, the students ceremoniously taped colored tissue paper to the windows in the arched doorway of the classroom.

At this point the conceptual and construction aspects of the building became inseparable. The children were not only physically engaged in making a window, but in a ritual that symbolically represented the importance of community and hope. When the children reflected on what they were grateful for, they focused on the importance of working together and not losing faith.

Their cathedral had become more than a building; it was a place that bound them together.

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Heathcote writes,

> ...to go beneath the outer form to the inner meanings.... This leads to the understanding of the significance of rituals, to the seeking for the nature of objects as well as the shapes of objects. It gives unity to experiences. It finds form everywhere, from the momentous form in buildings towering in space to the movements of a child in play. (Johnson, 1984, p. 33)

By the same token, this drama experience added to the children's understanding of architecture by actively engaging them in its concept and its construction.

SUMMARY

Educators today are broadening the ways they think about the nature of thinking and learning. What does it mean to know? How can what one knows be represented? These are questions being examined in the light of what Eisner (1989) calls the "new psychology." Human thinking and intelligence are processed in multiple ways, some dependent on language and some related to a more intuitive and aesthetic sense. Involving children in creative dramatics and interaction with picture books enhances learning through language and aesthetic experience. Looking through the dual lens of picture books and creative dramatics for the study of architecture served to link art, architecture, and a representation of different cultures for the children who took part in these events.

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Learner Generated Versus Instructor Induced Visual Imagery

by
James S. Lenze

Imagery

Imagery Types

The study of mental imagery is not limited to visual imagery, or the visual manifestations appearing in our minds. Millar (1990) clarifies the notion of mental imagery by stating that visual imagery is only one facet of mental imagery. Other forms of imagery are tactile imagery (imagining what objects feel like) and olfactory imagery (imagining what things smell like). Imagery types are only limited to the range of senses a person possesses. Images are direct representations of the things which they reflect. Millar (1990) states that images, "unlike arbitrary associations between words and things, 'resemble' the objects they depict" (pp. 129).

Associative Learning

Paivio (1979) discusses a theory of imagery called associative learning. He describes associative learning as playing a mediational role in various memory strategies. The associative view holds that mental images can be evoked by stimuli with which the imaged objects or events have been associated in the past, and that these visual images could themselves combine associatively.

A more specific discussion of associative learning is the concept of paired-associate learning. Pressley (1977b) describes paired-associate learning as a task situation where a list of pairs (usually pairs of words, pictures, pictures and words, or actual objects) is presented to a learner. Each pair consists of a stimulus item and a response item. The objective is to learn the correct response to each stimulus.

This theory revolves around the use of concrete and abstract concepts. A concrete concept possesses a high degree of physical qualities such as size and texture which can be consistently observed across a wide spectrum of individuals. An example would be an apple which could be consistently described as being rounded, smooth, red, and hard.

An abstract concept possesses fewer physical characteristics and is often harder to consistently define. An example would be love, which has many meanings, no discernable size or shape.

The more concrete characteristics a concept has the greater the concrete value of that concept. Paivio (1979) theorizes that the more concrete value there is to a concept, the more imaginal that concept is. With this in mind there exists a continuum of imaginability. This continuum is illustrated in Figure 1.

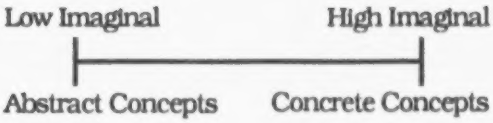

Figure 1. Continuum for imaginability of concrete and abstract concepts.

Paivio's (1979) concept of imaginability, tied to concreteness, agrees with Reese's (1970) research which indicates that it is easier to form visual imagery of concrete words than it is for absract words. Thus words which possess concrete value would be more memorable than words which possess virtually no concrete value.

To illustrate the theory of paired-associate learning, consider that the word "form" may have several meanings and can be quite abstract. To remember the word "form" a learner may develop an association between the word and a more concrete concept such as "a car." If the learner successfully develops an association between the word "form" and the concept of "a car" then the theory of associative learning states that the learner can recall the abstract concept along with the more easily remembered concrete concept (Paivio, 1969).

Paired-associate learning is the foundation of the conceptual peg hypothesis (Paivio, 1971) which Gambrell and Bales (1986) maintain is central to associative learning. This hypothesis assumes that "key images" serve as mental "pegs" to which associated information is hooked for storage and retrieval (Gambrell & Bales, 1986, p. 455). These pegs can occur naturally or can be strategically rehearsed to improve the chance of less salient information being retrieved (Sadoski & Quast, 1990).

Note that in the previous illustration the word "form" was hooked onto the image or mental peg of "a car." When such a pair is successfully associated or hooked together the learner can use the concrete image of "a car" to retrieve the abstract word "form". Taking the example further, if the learner is attempting to develop an understanding of the word "form" as it relates to artistic style then the learner can associate the word "form" with a particular "car", such as the Corvette which our hypothetical learner owns. When asked what is meant by "form" on a test the learner could recall the Corvette and remember that it's unique body style is an example of "form" as it is defined in this learning situation.

Age, Experience, and Memory Capacity

Another facet of imagery is one's ability to image and its apparent relationship to age. Research has shown that the greatest changes in visual imagery construction occur between the ages of five and eight (Youniss & Robertson, 1970). For this reason the ability to image has been assumed to be related to the age of the learner.

Pressley (1977b) disagrees, however that age directly influences a learner's ability to image. According to him the ability to generate internal visual elaborations is a developmental phenomenon and thus more closely related to age *and* experience. Pressley is not alone in his conclusion (Miccinati, 1982). In more recent work Pressley, Cariglia-Bull, Deane, & Schneider (1987) examined the hypothesis that a learner's ability to image goes beyond age and experience.

A number of studies, designed to look at memory capacity, support the use of imagery while reading for the improvement of recall for high school (e.g., Anderson & Kulhavy, 1972) and college-age students (e.g., Denis, 1982; Seingart & Glock, 1979). Cariglia-Bull and Pressley (1990) investigated the theory that individual differences in short-term memory capacity may affect children's success in carrying out imagery instructions. Indeed, short-term memory capacity may be a more critical factor in text learning than learning by listening (Cariglia-Bull & Pressley, 1990; Pressley et al., 1987).

Cariglia-Bull and Pressley (1990) found that short-term memory capacity relates to imagery and performance. They found that the greater the short-term memory capacity the greater use subjects could make of imagery instructions.

Pressley et al. (1987) found that those subjects with higher short-term memory scores were more successful at utilizing an imagery strategy than subjects with lower short-term memory scores. The conclusion from these results indicate that when learners are given mental control process instructions they rely on processes which do not put great pressure on short-term memory (Pressley et al., 1987).

Pressley et al. (1987) are then stating that imagery capability is not so much a product of age as it is a product of short-term memory capacity. If however, short-term capacity develops experientially then age, indirectly remains an indicator of imagery capability.

In any case, by the age of 6 or 7 years, children are capable of producing internal elaborations of paired associates. By the age of 8 years children can successfully apply the strategy of self-generated imagery to complex tasks such as prose learning (Lesgold, McCormick, & Goinkoff, 1975; Pressley, 1976).

Gambrell and Bales (1986) contend that the notion of imagery as unchanging mental images has given way to a new outlook. They state that the current conception of imagery is that of an active information-handling process. That imagery is an active mental process leads to the next concern of this examination: mathemagenic behavior.

Mathemagenic Behaviors

Rothkopf (1970) defines mathemagenic behaviors as those behaviors which "give birth to learning" (p. 325). He coined the term mathemagenic from the Greek root mathemain (that which is learned) and gignesthai (to be born).

The concept of mathemagenic behavior implies that the learner's actions play a key role in the learning process (Rothkopf, 1970). When the learner is exposed to some stimulus (i.e., prose) the information does not simply enter the learner's brain and stay there. There are mediating processes, under the learner's control, which either facilitate or interfere with learning the information. According to Rothkopf (1970) the chief purpose of the study of mathemagenic behaviors is to understand how the learner's cognitive processes affect the attainment of instructional objectives.

Mathemagenic Effects

Rothkopf (1970) describes mathemagenic behaviors as having two effects: (1) mathemagenic positive and (2) mathemagenic negative. Two other effects (mathemagenic neutral and mathemagenic unknown) are not directly relevant to instructional design and so will not be addressed here (Rothkopf, 1970).

Grabowski (in progress) identifies the first two effects as of primary importance to instructional design for their ability to describe a stimuli's effect on mental activity. A mathemagenic positive effect means that the stimuli was conducive to learning specified objectives. A mathemagenic negative effect refers to a stimuli's interference with the learning of a specified objective. Rothkopf (1970, p. 327) specifically describes mathemagenic behaviors as: "Those student activities that are relevant to the achievement of specified instructional objectives in specified situations or places."

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Classification of Mathemagenic Behaviors

Rothkopf (1970, p. 328) describes three classifications of mathemagenic activities. They are as follows:

Class I. *Orientation*: Getting Ss into the vicinity of instructional objects and keeping them there for suitable time periods. In certain institutional settings, this also involves control over activities that may distract or disturb other students.

Class II. *Object Acquisition*: Selecting and procuring appropriate instructional objects. Main-tenance of selection and procurement activities.

Class III. *Translation and Processing*: Scanning and systematic eye fixations on the instructional object; translation into internal speech or internal representations; the mental accompanyments of reading: discrimination, segmentation, processing, etc.

The first two classifications of mathemagenic activities are directly observable and to some degree directly measurable. The third classification contains some directly observable activities through the observation of biological functions, but also contains activities of a covert nature. These activities which take the form of cognitive processing can be inferred only through indirect observation (Rothkopf, 1970).

As stated before, activities within classifications I and II are mathemagenic so long as they can be directly inferred to be relevant to "the attainment of the performance specified by an instructional objective" (Rothkopf, 1970, p. 329).

It is imperative that class I and II mathemagenic classifications occur in order for class III mathemagenic activities to be inferred. This must be remembered as the remaining discussion of mathemagenic activities will focus on those inferred activities in class III.

Class III mathemagenic activities involve three actions which are discriminated by stimulus control and observable muscular action (Rothkopf, 1970). The three actions are translation, segmenting, and processing. These activities exist on a continuum as shown in figure 2.

Class Three
Mathemagenic Activities

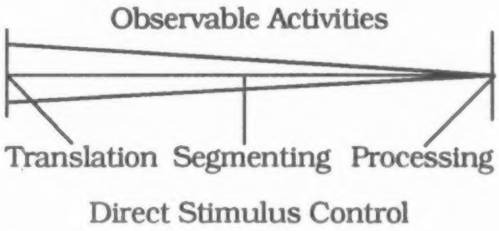

Figure 2. The continuum of mathemagenic activities for observable activities and direct stimulus control.

What this continuum illustrates is that an aspect of the first category of mathemagenic activities, translation, can be directly observed by monitoring eye muscle movements. In order for translation to occur the eye must first scan the text. These observations confirmonly that the learner's eye has scanned the page.

Structure of the text will dictate how the eye scans the page and so, to some degree, translation is also under under direct stimulus control. This means that the instructional materials control much of this activity. The direct opposite can be said of processing which is more independent of direct stimulus control and is quite covert. Rothkopf (1970) refers to processing as being on a "deeper" level than translation or segmenting (p. 329).

The translation stage involves a physical scan of the instructional materials and the creation of a mental representation of the instructional materials. Segmentation involves the linkage of information units during the scanning of instructional materials. Processing is the deepest stage. Rothkopf (1970) believes that it is at this stage that information is interpreted and review processes are initiated.

Inductive and Directive Control

The concept of mathemagenic control or manipulation is of interest to the instructional designer. Rothkopf (1976) refers to two mathemagenic behavior control techniques: directive and inductive control. Directive control refers to the selection of a processing technique which is induced by the instructional materials.

The instructional designer structures the lesson to induce the learner to utilize a specific processing technique. For instance, the instructions for a particular unit may read "Tropical rain forests are lush, green forests which are located primarily near the equator. Picture in your head a tropical rain forest." This instruction is attempting to induce the learner to utilize visual imagery as a processing technique. As shown in the above continuum such control is not necessarily an easy task. Inductive control refers to instructional activities which facilitate processing, though the type of processing is left to the learner's judgment.

Arguments over which type of control better facilitates learning continue (Grabowski, in progress; Jonassen, 1988). Incorporating control of mathemagenic behaviors into instructional materials is the concept of Frase's (1969) cybernetic control. Barry (1974) asserts that mathemagenic behavior is a learning variable which can be manipulated by the experimenter or instructional designer. He believes that control of these behaviors is better incorporated into the instructional materials than vesting it with the learner. Thornton, Bohlmeyer, Dickson, and Kulhavy (1990), however, state that imposed processing strategies may interfere with processing strategies which the learner is already familiar with and prefers. While the manipulation of mathemagenic processes is possible, not all mathemagenic activities can be controlled (Rothkopf, 1970).

Kardash and Amlund (1991) conducted an investigation of those overt and covert information-processing activities used by learners. A subsequent investigation revealed that no consistent relationship existed between any covert and overt strategies (i.e., the use of a particular overt strategy does not guarantee the use of a particular covert strategy).

Grabowski (in progress) explains that the important outcome is to facilitate active mental processing in learning. It is a well accepted concept that learners who are actively involved in the learning process learn more than those who take a passive role (Sutliff, 1986).

Generative Learning

Wittrock's generative learning model (Wittrock, 1974a, 1978, 1981, 1990; Wittrock and Carter, 1975) is a process oriented cognitive processing model that assumes that the reader actively generates two types of relations: "(1) between the text and the learner's knowledge and memories of experience, and (2) among the units of the text, such as the words, sentences and paragraphs" (Peled & Wittrock, 1990, p. 175). Carnine and Kinder (1985) observe a seemingly synonymous relationship between generative strategies and schema theory (e.g., Mandler & Johnson, 1979; Thorndyke, 1977). They state that schema theory "attempts to explain the organization and integration of new information with previously existing information" (Carnine & Kinder, 1985, p. 21).

Teachers can utilize the generative model by encouraging their learners to attend to the text, relate it to their own knowledge and experience and then build associations, abstractions, and inferences from it (Linden & Wittrock, 1981). The generation of associations and relations can be facilitated through the use of verbal representations (Linden & Wittrock, 1981). Learners can generate verbal representations through the use of "text-relevant summary sentences, headings, inferences, main ideas, critical comments, and evaluations" (p. 45). Imagninal representations, such as pictures, images, graphs, illustrations, diagrams, and drawings can also be used to generate associations and relations.

In the generative model oflearning "teaching that induces learners to perform generations relating the parts of the text to one another, or to the readers' background and experience, enhances comprehension" (Linden & Wittrock, 1981, p. 54). Wittrock's research (Doctorow, Wittrock & Marks, 1978; Linden & Wittrock, 1981; Peled & Wittrock, 1990; Wittrock & Carter, 1975) demonstrates two learner behaviors in the generative learning model. They are:

> Learners construct meaning of the text by using their information processing strategies, aptitudes, and stores of specific memories to generate interpretations of the written material (Peled & Wittrock, 1990, p. 175).

and

> Learners use their strategies, aptitudes and memories to generate meanings by constructing relations among text units and across text units and information stored in the memory (Peled & Wittrock, 1990, p. 75).

The model of generative learning implies that a learner must be active in the generation of relationships, activly involved in the instruction, attentive to informationional structures, and aware of those mediational processes being used (Wittrock, 1985).

The fundamental principle of the generative model of learning is "that people tend to generate perceptions and meanings that are consistent with their prior learning" (Wittrock, 1974a, p. 88). Wittrock (1974a) contrasts the generative learning model with the concepts of meaningfulness or semantic processing models by explaining that the generative model predicts "that learning is a function of the abstract and distinctive, concrete associations which the learner generates between his understanding, which is defined by long-term memory, and the stimuli" (p. 89).

Wittrock (1974b) stresses that instructional designers should look beyond the instruction as nominal stimuli and see it as what it becomes to the learner based on the learner's individual context. The focus is not on what the instruction does but rather on what it causes the learner to do (Wittrock, 1974b).

Generative Learning as a Sub-set of Mathemagenic Behaviors

Peper and Mayer (1978) refer to the existence of mathemagenic and generative learning as contrasting. How can a mediational activity be both? Rothkopf (1970) refers to mathemagenic behavior as any behavior which induces learning. Generative learning also refers to behaviors which induce learning. But since generative learning requires the construction of new meaning from the assimilation of informational units it becomes a distinctive subset of mathemagenic behaviors.

Grabowski (in progress) provides an explanation as to how generative learning relates to mathemagenic effects. She explains that since generative learning refers specifically to mental activities, or conscious, covert mental processing, it is much more defined than mathemagenic effects which refer to all covert and overt, conscious and unconscious mental processing. She states the logical premise that since mathemagenic processing includes covert, conscious processing generative learning is a mathemagenic processing subset. "All generative learning produces a mathemagenic effect, but not all mathemagenic activities can be classified as generative" (Grabowski, in progress, p. 10).

So is note taking a mathemagenic activity or a mathemagenic/ generative activity? It depends on the nature of the activity. A note taking activity which involves elaboration of the presented information will require that the learner access prior knowledge and process the old and new information together thus generating a new and idiosyncratic meaning beyond the presented information. If, however, information is novel to the learner Peper and Mayer (1978) state:

> A tentative hypothesis is that when the material is unfamiliar and subjects have not developed efficient encoding strategies, mathemagenic activities aimed at encouraging assimilative rather than additive encoding are likely to be most successful (p. 521).

Peper and Mayer (1978) raise the interesting question of which approach is better: an instructor provided or learner generated approach to designing instructional materials. Discussed previously was the controversy over whether instructional designers could impose a specific processing strategy on learners through the manipulation of instructional materials and activities.

Rickards and August (1975) in their study of generative underlining found that subjects retained more information from prose which they underlined (learner generated) than from prose underlined by the experimenter (instructor provided) or not underlined at all. Rickards and August (1975) maintain that when a learner is permitted to underline any text which they deem important they exercise the freedom to select those passages which best "fit" their idiosyncratic cognitive structures and are better able to assimilate the new information with already existing information.

Rickards and August (1975) also observe that incidental learning is increased by a generative strategy. The assumption is therefore made that learning is a constructive activity and that those instructional activities which are generative in nature will best foster learning (Rickards and August, 1975).

Imagery Research In Mathemagenic Behavior

Embedded questions, as mentioned before, are most often used to induce mathemagenic behavior. Research focusing on imagery, however, has greatly illuminated the relationship of mathemagenic/instructor provided and mathemagenic/generative inducing activities.

Instructionally Induced Imagery

Anderson and Kulhavy (1972) investigated the effect imagery instructions had on learning from prose passages like those found in text books. They found that providing learners with instructions to use imagery does not mean that they will necessarily do it. One third of their imaging subjects reported using imagery only at the beginning of the study or not using imagery throughout. Additionally, more than half of their control group, who received no instruction to image, reported using imagery during the study. Their conclusion was that providing instruction to image while reading text does not assure that learners will employ that strategy. Nor does not providing instruction assure that learners will not utilize the strategy. These findings agree with Thornton et al. (1990) who found that learners will often rely on previously adopted strategies.

An alternative to Anderson and Kulhavy's (1972) approach would be to provide encouragement to utilize a specified strategy. Lesgold et. al. (1975) attempted to induce mental imagery through the use of learner generated imagery and prompting. Subjects were instructed to generate stick figure illustrations after reading a passage of text. They were to use these illustrations as prompts for remembering details from the passage of text. Throughout the instruction subjects were encouraged to illustrate every picturable fact from the text. The subjects (third and fourth grade students) were permitted to examine the text while generating the illustrations. The experimenters believed, however, that such a review would become less frequent as subjects learned to gather facts for illustrating while reading.

It is important to note that, although the imagery instruction was shown to significantly improve recall of information, subjects neglected to utilize the strategy unless they were reminded to do so (Lesgold et al., 1975). This study seems to reinforce the theory that a mathemagenic/generative form of imagery instruction facilitates the recall of prose information. This study, however, stipulates that content was highly imagible. Complex or unfamiliar images were not studied.

A further improvement upon Anderson and Kulhavy's (1972) approach was that utilized by Carnine and Kinder (1985). They incorporated an overt activity, verbalizing generated visual imagery, to help induce the use of imagery in their subjects. Although the use of corrective feedback cannot be ignored, Carnine and Kinder (1985) maintain that the addition of an overt activity may direct learners to utilize imagery as a mediational processing technique.

Carnine and Kinder (1985), Lesgold et al. (1975), and Anderson and Kulhavy (1972) demonstrate that the use of imagery as a mediational processing technique facilitates the learning of information from prose. They further demonstrate that the utilization of an overt activity can induce a learner to utilize a specified strategy; in this case imagery. Underlying both of these considerations is the notion of utilizing a generative approach to structuring instructional events; a notion which all of these studies support.

Bull and Wittrock's (1973) study compared fifth-grade students ability to remember the definitions of nouns across three treatments. The first treatment involved "self-discovered" images. The second treatment involved experimenter provided images, and the third treatment was provided with verbal definitions alone. They hypothesized that the two imagery groups would remember more definitions than the verbal definitions alone group and that the self-discovered images group would perform better than the experimenter provided images group. It is logical that Bull and Wittrock (1973) would assume that the imagery groups would facilitate storage of definitions better than non-imagery groups (Taylor, Josberger, & Prentice, 1970; Anderson & Kulhavy, 1972).

The results of Bull and Wittrock's (1973) study indicate that the self-discovery images group performed better on recalling definitions than did the experimenter provided images group. Both groups did, in fact, perform significantly better than did the verbal definitions alone group. Subjects were not tested on their ability to image. Whether they actually utilized an imagery strategy is unknown.

Further research exists which supports the hypothesis that mental imagery facilitates reading comprehension (Gambrell & Bales, 1986; Gambrell, 1981; Giesen & Peeck, 1984; Peters & Levin, 1986; Pressley, 1976, 1977a; Sadoski, 1983, 1984, 1985; Steingart & Glock, 1979). The idea of self-discovered imagery producing stronger effects than experimenter provided images is in line with generative learning theory (Wittrock, 1967), since self-discovered images are more idiosyncratic they will act as a higher associative mediator (Bull & Wittrock, 1973).

The notion of imposing an imagery strategy on the learner reopens the controversy of instructionally manipulated processing strategies. Recall that Thornton et al. (1990) state that imposed processing strategies may interfere with processing strategies which the learner is already familiar with and prefers. This would seem to contradict the above findings that the imaging strategy was imposed with successful results. But it should be remembered that research has shown that by the age of 6 or 7 years, children are capable of producing internal visual imagery and that by the age of 8 years children can successfully apply the strategy of self-generated imagery to complex tasks such as prose learning (Lesgold, et al., 1975; Pressley, 1976).

It would seem logical to infer that imagery is a strategy which learners develop and utilize at a relatively early age. Attempts to induce learners to utilize such a strategy are therefore not imposing a novel method upon the learner but are rather encouraging the learner to utilize a strategy already in their repertoire.

There is a particular issue which the literature indicates researchers, interested in imagery, have yet to fully explore. That concern is the idea of idiosyncratic images acting as higher associative mediators. While this may well be true for the learning of definitions and familiar concepts it is a questionable technique when the object is to learn an accurate spatial understanding of a complex and/or unfamiliar concept. A learner could be said to possess spatial understanding of an object when he/she can accurately identify or illustrate a simple representation of the object.

For instance, if average American learners were required to generate a mental image of a "fire truck" they would probably be able to do so. There would also be little doubt that while each individual's image would possess some common qualities (wheels for instance) they would also be quite idiosyncratic. In this case the theory that a generative approach of imagery production would better facilitate the retention of the word "fire truck" would probably be validated.

But what if the learner were asked to generate a visual image of an unfamiliar concept such as a "plant cell." If learners are unfamiliar with what plant cells look like the best they may be able to do is generate a paired-associate such as generating a visual image of a tree in a jail cell (the stimulus) with the term plant cell (the response). While the visual image may aid the learner in retrieving the information concerning a plant cell it will not aid their spatial understanding of what a plant cell looks like.

If the instructional objective is to develop or identify a spatial representation of a novel object, then the paired-associate method will fail to help the learner develop such an understanding. Remember that Peper and Mayer (1978) stated tentatively that if material is unfamiliar to subjects a mathemagenic/instructor provided approach may be more successful than a mathemagenic/generative one.

This falls in line with Anderson and Armbruster's (1990) concept of modeling. By providing the learner with an example of what a plant cell looks like the learner can then match the provided image with the associated term and information. Although no generation of an idiosyncratic meaning is fostered, the instructional objective of developing a spatial understanding would be met.

A fundamental question, which must be asked, is whether or not the learner is utilizing visual imagery as a mediational force during either the mathemagenic/instructor provided strategy or the mathemagenic/ generative strategy. By imposing an instructional activity which requires the learner to utilize a visual strategy (copying, tracing, drawing, etc.) the instructor should be able to determine whether the learner utilized the desired mediational force under the premise that the successful completion of such an activity would both induce and encourage the use of visual imagery. In other words, learners would be unable to successfully complete an evaluative measure involving identification or drawing unless they possessed an accurate visual image of the object in question. This notion is supported by Linden and Wittrock (1985, p 55) who state "The measures of learner generations clearly indicate, independently of the retention, comprehension, or other dependent measures obtained later on separate tests, the existence of the functional treatments" (Linden & Wittrock, 1981, p55).

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An Introduction to Educational Holography

by
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Holograms and the effects of holography are all around us in this country. They are most evident in three general applications fields of holography that have emerged since the mid-1960's, when lasers became available to be used as a light source for making holograms. These fields are: display holography (popular commercial and fine art images), holographic non-destructive testing of materials (technology of holometry), holographic optical elements (Museum of Holography, 1983).

Holograms are capable of taking the current two-dimensional ways of envisioning information to another dimension of presentation, representation, and conceptualization. It is in this context that educational holography is now emerging as a distinct, fourth major application; one that is no longer seen as exclusive to the training of holographers, but one that can benefit learning in all disciplines.

Two broad arenas of significance for this fourth field are:

1. expanding the diverse educational roles of holograms, themselves, as a tool for showing visual information in ways that print and electronic media can never comparably approach (precise size replication of objects in length, width, depth with parallax, and options for demonstrating motion);
2. and exploring holography conceptually, as a way to restructure the assumptions of critical, basic elements of visual literacy to become consistent within and between the disciplines of the arts and sciences.

The purpose here is to present holograms and holography in the service of general education and visual education. Holograms will be explored as educational tools to be used more widely for visually explaining information to everyone. Positive ways to make use of the mass-marketed, commercial and popular holograms, in the service of several educational purposes, are also suggested. As holograms and their educational uses are discussed, unique characteristics of the medium will also be highlighted.

The practical use of holograms, and the enhancements of concepts about the visual nature of actual objects and images, will often be presented together here. This is because the curious visual phenomena displayed by holograms will often spur the reader to want to know, immediately, why or how that characteristic comes to be. If someone tells you that she has just turned an object inside out, it is reasonable to suspect that you will want to know more about this with little delay. It is also done this way to encourage more conscious thought about what is seen, when looking at something.

Since the act of seeing among sighted people is so common and unconscious, very few people, even among those deeply involved in the visual arts, take the time to seriously investigate the assumptions by which their own visual literacy is structured. Those who have not begun to conceptually accommodate the visual characteristics of holography to their visual literacy structure, operate by and perpetuate visual misconceptions and frailties embedded in culturally-based, 2-D dogma.

See for yourself. Closely investigating the hologram on your credit card can be a good place to begin. Looking at holograms contrasts greatly with looking at 2-D images, and even other forms of 3-D optical imaging. Serious investigations, of what holograms do and why, will inevitably lead to the exposure of assumptions about what each of us thinks he or she sees, and, as a result, will accent many conflicts between them and what holograms demonstrate.

When the author's more serious visual investigation of holograms began, the novelty of holograms was replaced by a desire to do more than casually reconcile or ignore these mysterious conflicts. Holography has prompted a more engaging effort toward identifying a consistent set of fundamental, cross-disciplinary, visual phenomena to be considered in the restructuring of basic visual literacy.

Introduction

Holography is based upon a unique way of precisely recording light interactions as wavefront interference patterns (Gabor, 1972). In holography, the interference pattern captured in light-sensitive recording film is called a hologram. In order to record the fringes of light, necessary for a holographic interference pattern, a coherent light source such as a Helium Neon (HeNe) laser is imperative.

A hologram is made from the coherent light directed onto the holographic recording film (reference light), combining correctly with the light reflecting from or through the object being recorded (object light), in the light-sensitive recording material. Individual units of light (best described here as wavefronts of light) from the object and from the reference light meet, and in varying degrees, interact positively or negatively. Where they meet more negatively, little or no light is recorded, and where they meet more positively, light is recorded in the holographic film. This recording becomes a series of microscopic fringes of positive and negative interference on a fraction-of-a-wavelength level. The recorded fringes of wavefront interaction, resulting as an overall holographic interference pattern, contain wavefront information about the amplitude, wavelength and phase of object light, compared with the reference wavefronts.

The nature of this pattern requires that, in order to view the object information, an appropriate light source be directed at the hologram in the same place as the reference light was when it was created. (Otherwise the hologram looks like nothing, or nothing recognizable.) Under this correct illumination, the fringes in the interference pattern will select out certain wavelengths, to reconstruct the wavefronts of the object, to appear at the same locations in space from the holographic recording material, as they were during the recording.

Holograms record and reconstruct the phase information of an object's light, in addition to wavelength and amplitude information, in direct relation to the wavefronts of the reference light that illuminate them. A non-holographic, photographic, process can only record a pattern of brightness from the object, even if a HeNe laser and holographic film were used, because the phase information will not be recorded in an immediately accessible way.

It should be mentioned early that there are many ways to optically record, create, and display the illusion of a three-dimensional reality -- from many simple stereographic techniques used in photography and printing, to the latest advancements in virtual reality machines. Each has not strengths and weaknesses, but more and less appropriate applications to be determined by the context in which they might be used. Among these 3-D media, holography is the first and only one that can faithfully record and later reconstruct objects with the object's exact, functioning, optical properties as wavefront information.

The holographic process is not limited to recording only images from the original objects. Holography can be used to synthetically represent actual objects from a specially animated series of 2-D images which may exist among things we see, cannot see, or will never see (such as mathematical formulas), into the three spatial dimensions, with motion or time. Parallax can be constructed by "holoptically" combining logically animated sequences of 2-D views. The holographic aspect seen involves the reconstruction of the series of flat views, so that they optically blend together in space and appear as a solid entity. Anything that is able to be represented graphically, in appropriately animated sequences, can be synthesized to exist three-dimensionally as a form of holographic stereogram.

Educational applications of mass-produced holograms

Embossed holograms are probably the most widely seen mass-produced holograms. They are the ones produced with rainbow-colored images on silvery backgrounds, often found on printed matter or on plastics as stickers. Perhaps the first embossed holograms to become widely known were the three published on covers of *National Geographic*. The first hologram of a crude model of an eagle was embossed onto the cover of the March, 1984 issue. It was the largest run embossed on a magazine to date -- several million -- proving holography to be an extremely viable mass-communication medium in the print world. It was quickly followed by the Taung skull (which was more than twice the size of the first), also embossed onto several million covers for the November, 1985 issue.

Each issue marked a significant advancement in the size and creative imaging capabilities of embossed holography in printed media. This magazine's last holographic accomplishment, for the December, 1988 issue, was a totally embossed front cover, back cover, and spine -- not a molecule of printing ink.

The embossed form of holograms can be:

- of objects holographed directly, as the model of the eagle or the Taung skull,
- as a holographic stereogram from animated flat images,
- as a flat graphic such as the credit card graphics,
- or as a "non-objective" holographic optical element such as diffraction grating.

There are dozens of very inexpensive holograms available as demonstration resources, ranging from past magazine covers, toys, and cereal boxes, to popular holographic images sold in the shopping malls across the country. These display applications are most often seen as commercial art, but also have a strong application as a fine art medium. The popular and commercial image markets have helped bring more holography into the hands of more people than fine art holograms. There are benefits and there are drawbacks to this.

Often commercial clients for holograms have cut corners on aesthetic quality, for quantity of sales. The same problem has occurred throughout the history of all stereographic processes too. This has led many lazy viewers, artists and critics included, to somehow think that these images were the only ones being created, and somehow represented the zenith of artistic exploration in the holography medium, and in 3-D imaging in general.

Ask a crowd collected for a talk on holography, what names they associate with holograms. The names will not be those of veteran artist holographers who have shown in dozens of museums and galleries all over the world such as Benyon, Deem, Berkhout, Moree, Crenshaw, or Wesly, but *National Geographic*, 'those trading cards,' 'that cereal,' 'the credit cards with the bird,' and so on. People often have seen holograms, but rarely ones that challenge the potentials of the medium. It is like judging the images in print by the ones found in junk mail. The commerciality of holograms has been a mixed blessing in educating people about holography.

Rather than turning up a nose at some of these images, it would be better to put these holograms to work positively in education. Exposing students to three-dimensional imaging for more than the image content could stimulate early interest in science, as well as show room for improvement in the art and design sides.

For example, simple investigation of common holograms, that may be far from an art museum's aesthetic, can still yield other exciting results. By holding one of the silver-backed holograms upside-down, the image will "turn itself inside-out" and reverse its depth. The questions that result from this first level of exploration are immediately very challenging to our common perceptions about how images from a flat surface should behave. How does this holographic image do this? What seems to be happening? Why does the image exist as it does normally?

Children are curious to know how and why things work. The teacher will have to investigate 3-D imaging, some basics concerning optics, and may be moved to check up on some of the fascinating history of this Nobel Prize-winning medium. Children may listen to a statement like "Scientists are explorers also," but when they can explore science, the proposed idea meets the reality of the task they are performing with holograms.

Holography was a mistake that was discovered in pursuit of solving another problem involving electron microscopes (Gabor, 1972). The idea for holography was explored through the ideas of many scientists. Holograms, in an historical context, can be used to trace that history of ideas and learn about optical principles demonstrated by holograms. Here is where the teacher can also be very inventive, even though the most common, popular holograms are being used for demonstration.

Suggestions for developmental levels, for educational applications of holograms in the classroom, are not yet in place, because educational holography is such a new idea. The information surrounding holograms does exist in developmentally staged approaches for teaching -- the study of light, simple optics and so on -- and can be introduced appropriately from this experience.

Another example of an educational use for existing holograms involves children, young and old, with hands-on investigations of the different results obtained from different lighting and light sources for holograms. Students can see for themselves which light bulbs work better or worse, and set up simple scientific investigations. Observations and comparisons from looking at holograms and ink-printed text through different colored transparent gels can involve the students in exercising new visual experiences and connections. This kind of basic investigation and problem solving, involving the visual world, also brings up students' common levels of visual literacy, and bridges between the visual basics of the arts with the sciences.

There are relationships between the color of light and the color of objects that should not be exclusive to any one discipline of study. Working with holograms invites interdisciplinary introductions to light in a way that involves students. Edwin Land did an extensive series of experiments about the perception of color reflected from different pigment colors that were illuminated under different wavelengths (colors) of light (Land, December, 1977 & 1990). Older students of physics, psychology, and art alike, would benefit by experiments using common holograms and different colors of light for clarifying that pigments are materials, not colors. Holograms will never be understood without discovering these kinds of basic concepts.

These concepts then can be used to challenge other common assumptions about the visual world. In art classes, the traditional color wheel is based on pigment colors whose primary colors are red, yellow and blue. In science class, the primary colors of light are red green and blue. At an early age the distinction could be demonstrated and at a later age explained more in depth along with examples of subtractive and additive color.

Explanations of three-dimensionality can be aided by the use of common commercial holograms too. While it is important to learn the western, 2-D languages and symbol systems for picturing depth and dimensionality, it is also important to know about the physics, psychology and physiology of light and dimensional perception. Holography provides an excellent springboard into investigating this subject.

This is not only an issue for the sciences mentioned, but also one that is cultural and artistic. Students can evolve their study of how they see "mechanically," to how they and people from other places visually perceive pictorial languages -- people give images meaning. A curious aspect of this cultural interpretation is exemplified beautifully by showing people of all ages and backgrounds different holograms of people (recorded with a very powerful pulse laser). It appears that many people, especially adults, would not like to have a holographic portrait of a loved one displayed at home -- the response, more often than not, has been that such a hologram is "too real" and ultimately "too creepy".

Now that the general public is used to photographs, movies and television images of people, why have so many adults interpreted holographic portraits as "too real"? This dimension of holography was very surprising. Could this uneasiness be changed by reducing the portrait size and scale? Is color a major factor? Would achromatic portraits be more quickly and easily accepted? Are Americans the only ones who feel this way?

Popular holograms whose images reconstruct animals and sometimes optically interesting phenomena may not have the aesthetic depth of those produced by serious, practicing art holographers, but can be used as a focal point for introducing topics in creative writing, poetry, and literature. Once again, young children enjoy playing with light and looking at plants and animals. There are dozens of holograms, whose images are of animals such as birds, puppies, snakes, spiders, kittens, clowns, and even children. Small, pleasant-looking images of children and animals have not seemed to be upsetting to children from my observations -- the response is actually the opposite. These kinds of images range in size from 3" x 3" to 12" x 16". Prices range from $5 to $75, usually according to size.

A story about an animal can begin with the hologram to attract attention, and focus the story topic. The students can write about the dog in the hologram, and why this one might be so special. Poetry topics can be involved in similar ways. It is another opportunity for education to become more creative for the student and the teacher, and for science to enter the arts in a positive way.

Holographic diffraction grating can be purchased for a few dollars per square yard. It can be used to illustrate science lessons about light diffraction. It is inexpensive enough to be cut up and distributed among the students as a material to use in making art. Younger children often prefer diffraction grating to holograms of recognizable images probably because the diffraction grating is far more colorful, visually kinetic, and can be transformed into designs under the child's control. Projects for elementary children with this material have included making jewelry, buttons, postcards, abstract and realistic collages with other colored materials, logo designs, typography, and more. This introduces the colors of light with the colors of pigments. It also helps convey the idea that color is light, not something material. The flashiness of the spectral diffractions from this material also brings a bit of excitement from science to art. Optical manipulation of light normally done only with prisms or oil-slicks is expanded to new experiences.

The contexts of using the holographic diffraction grating material could also be played with -- to what other functions could this material or variations of this material be applied? Holograms need to be experimented with visually and conceptually in different materials contexts, so that the other materials as well, become better known from their contexts with holography. A stripe, rectangle, or sharp triangle in construction paper placed with similar shapes of holographic diffraction foil, provides contrast in shape relationships on a page. It also adds new understandings of depth relationships where the holographic material extends colored light into or above the surface of the paper.

Making Holograms

When holography was invented in 1947 by Dennis Gabor, the laser did not exist. In 1948, the most coherent light source he could find for the first experiments in making holograms was a high pressure Mercury lamp (Gabor, 1972). The coherent light of a Helium Neon (HeNe) gas laser is now most often used to make holograms in the holography lab of artists and schools. This laser light is desirable for making holograms for several reasons:

- it emits pure monochromatic light (only one wavelength/one

color);
- the light is coherent -- essentially promoting the ability of the phase information of light to be recorded intact as object/reference interferences fringes;
- and the light travels in a straight line making it highly directable.

Because of federal standards of laser safety regulations, HeNe lasers of under one miliwatt of output should be used in a demonstration context for schools, unless there is a teacher on premises who is a certified laser safety operator. The low-watt HeNe lasers used in holography do not burn. The greatest danger from the HeNe laser (or any light source) exists in looking directly at its concentrated beam of light. These one-miliwatt lasers easily expose film sizes at, or under, 3" x 3", which is an excellent demonstration size for schools. The holograms made, should always be ones viewable by white light to avoid problems with laser-viewing, and, because an appropriate clear, single-filament, incandescent light bulb, will cost about 69 cents. Exposing holograms in sizes larger than this requires that the laser light is spread out more to cover more area. This will weaken the intensity of light and require longer exposures under extreme anti-vibration conditions.

The film typically used with the HeNe laser is a glass-based or triacetate film, coated with the light-sensitive emulsion of hyper-fine Silver-Halide suspended in gelatin. The cost of a one-miliwatt, used laser can be under $100., and a box of 100, 4" x 5" sheets of triacetate base film should also be under $100. Some developers can be found in better photography stores, or made from scratch from chemicals on hand in the school chemistry lab, or ordered in bulk by mail. With a bit of thinking and successful conversation, portable educational labs for schools can cost under $1000. Holographers will always offer advice and must be consulted in the start-up stages to better guarantee early success. Even the best written materials cannot assess expectations or the conditions under which a holography setup is expected to function.

Several schools are taking advantage of learning from existing, mass produced holograms and are making their own holograms in the classroom. This is where the discovery in the arts and sciences can truly soar. At the end of manipulating ideas initially based in physics, chemistry and art, there will exist a hologram as evidence that can be shared and investigated further by students, teachers, parents and the community.

Between 1984 and 1989, I built the first collaboration between the original Museum of Holography (M.o.H.) and twenty school districts across New York State called The Holography in the Classroom Project (H.I.C.P.) (Lloyd, Spring, 1986). This project involved thousands of high school students, and over a hundred elementary students, in holography. We built nine permanent or temporary holography labs in high schools, and one portable lab in an elementary school. The students were sponsored by at least one teacher, personally trained by the author, through the M.o.H., Educational Services Department. This information was then passed on to the students and whenever possible, to other teachers in other disciplines in the district, and shared at conferences in the arts and sciences.

At a time when non-profit and educational funding was plunging, and grants were extremely competitive, holography enjoyed very reasonable support. Through the Museum, the author wrote H.I.C.P. grants for over $35,000 from the Arts in Education Program of the New York State Council for the Arts, in collaboration with interested schools and the N.Y. State Education Department. Teachers from all over the state of New York were invited to become involved. The participating teachers were from formal disciplines in either English, Physics, art, general science, computers, or marketing.

The focus of the H.I.C.P. was to create a collaboration between the teachers and the director of the Educational Services Department at the Museum, where holography would be developed as a curriculum enhancement tool. Many exhibitions of student work, community publicity, and a unique project that led high school students to design and mass-produce their own world-first hologram on the cover of their yearbook, were some of the more obvious achievements.

Less obvious are the behind-the-scenes processes necessary to create a successful hologram. These can be small administrative coups, as in the H.I.C.P. high school that convinced the male faculty to relinquish a restroom for a holography lab. Another was the convincing of community businesses to donate materials for a vibration isolation table and glass for the film holder.

There is something very magical in the process that is at least equal to the practical, physical considerations. The working conditions involved with holography are more extreme than in photography. Unlike photography, the anti-vibration factor in making holograms is critical. It makes the holographers hyper aware of the sources of the slightest sounds or vibrations. During the dark time in shooting holograms, the room must be kept nearly totally dark -- even though the film is slow, it is being manufactured at more panchromatic sensitivities.

When making holograms, often story telling occurs during the "dark time". Working with the intense red "cream-of wheat" texture of laser light always reminds holographers that they are doing something different, something special. The intense precautions against vibrations that often humans cannot perceive seem superstitious. Processing no "picture", and not being able to confirm successful results until the hologram is dry and receives the correct light and angle of illumination, can become a kind of ceremony. These are some things that all holographers share.

In display holography, especially, the variety and diversity of backgrounds and cultures of people involved is astounding. While there can be drawbacks to making holograms such as the anti-vibration factor, the youth of the medium can also yield a vital community, filled with sense of sharing a very special activity. An artist will show some compound lens distortion techniques recorded purposely to create a wild bouquet of colored light to a scientist who sees beauty in something he was trained never to do with holography. The scientist shows the artist a hologram of a wavefront of one pulse of light travelling over the surface of an object. Imagine, a hologram of just a piece of light; the artist finds beauty in scientific observations as well.

A holographic image may display curious tiger, wood-grain, or concentric stripe patterns. These were not created by a change in color on the object but a change in the light coming from the surface of the object. During an exposure with a low-power laser, if the object moves more than a quarter of a light wave, the object, or the part of the object that moved will not constructively record its interference pattern correctly. Double exposures of objects, with a slight variation in the object's surface from pressure or temperature introduced between the exposures, will record the same object twice in the same place noting the degrees of differences by striped patterns. The dark stripes are where the light destructively interacted; the light stripes indicate where it was positive.

Artists control this for a visual effect, while scientists use this to gather important information about changes in materials and products. This way of recording represents one of many forms of holometry -- holographic non-destructive testing. It is a scientific application to determine points of surface change in objects and volume change in gas and liquid. Formally and conceptually, artists can explore change as art or just use the stripes as a decorative element.

Holographic optical elements (H.O.E.'s) use the optical properties of holograms to create holograms whose purpose is not to reconstruct objects but the optical manipulation properties of refraction, reflection, and diffraction. Complex, lightweight optics have made possible diffraction grating discs used in laser scanners, such as the ones in supermarkets, that could not have been created without holography. Head-up displays in car windshields and pilot helmets can optically locate light information into space at precise distances.

This type of hologram is also employed in solar collection as a way to always catch the most intense direction of sunlight and refocus it to solar stationary collectors. A twist on this last idea is being considered for holographic windows to direct more sunlight to poorly lit rooms in tall city buildings. How might students want to creatively manipulate light holographically in ways not yet imagined?

Artists have used H.O.E.'s to create art that is totally non-objective. At this level the artists are truly sculptors of light itself. Brilliant bursts of rainbows can be orchestrated by the artist to appear and disappear in space as the viewer walks by, or moves up and down. Light can be made to appear at only one location out in space where the mind is not used to looking for information. Some viewers can miss information that artists present because their minds have been trained to focus only at the surface of artworks -- imagery is not supposed to just appear without a location to a surface in space under the rules of drawing and painting.

Non-destructive testing and holographic optical elements can also be made in the school lab with the one-miliwatt laser. As students and teachers spend time investigating holography, it becomes evident that holography truly is something special, something magic. The questions it poses and the elegance of some of the solutions it demonstrates regarding aspects of visual realities, perceptions and myths have to be presented very poorly in order to become uninteresting.

For example, one of the latest frontiers related to, but not entirely consistent with holography, is phase conjugation (Leith, 1986). It is a new application, also called "transholography" (Denisyuk & Gurikov, 1992), that addresses elusive, complex issues involving time-reversal. Exploring this area cannot happen in the school lab currently, but the school lab can spawn discussion that can be assisted by basic knowledge in holography.

Holography in the service of visual literacy

The ways in which people communicate by graphic information will dramatically change after experiences of making holograms, if people pay close attention to what holograms are demonstrating. This does not mean that people will be suddenly or exclusively thinking "holographically" (what ever that means), stop drawing pictures, or insisting on taking up residence in a holography lab. What it means is that a new, clearer awareness of light at the core of organizing information involving visual literacy will emerge. Making holograms and seriously exploring what holograms do, can help to challenge the inconsistent, patchwork of current assumptions. When a hologram of a baseball gets the top left corner cut off and the whole baseball can be seen through the much smaller hologram piece, it should not just instigate questions about how a hologram does this but add to information about how light itself functions.

The "age of information" is hopping a ride on the "age of light" for the next century. Theoretically, it has been suggested that the contents of the Library of Congress could be recorded holographically into in a volume that will fit on a spoon. This is difficult to write, let alone imagine. Schools have to prepare the next generations for these levels of challenge. The information cannot all be shared exclusively by reading words. Visualization of information will increase in educational importance, and 2-D images are not able to accept the entire burden.

When explaining holograms briefly in this paper, it would have been lovely to have the hologram not yet made, that showed light moving from the laser, to the film and object, and on to create the interference pattern in the film -- three-dimensionally, with parallax, and with movement. 2-D graphics that become part of the language and symbols of holographers, can be immediately understood by holographers, who are already fluent in the basics. 2-D graphics rarely have helped holography novices make immediate transitions from words about the medium, to the flat diagram, to an accurate mental picture, especially in an article of this size.

Fluency in the concepts and functions associated with holography are also rarely present or consistent among novices as well. This suggests that learning more about holograms also means that disciplines within the arts and sciences will have to open their doors to sharing information; that collaborations in investigating new assumptions about the structures of visual literacy can no longer exist in exclusive domains of academic disciplines.

Educational holography will not solve all of the problems for visual literacy. It will show where problems exist, and suggest points of connection between it and other disciplines, from which to begin. Its newness is exciting, and when introduced in a non-intimidating fashion, extremely inviting. As holograms begin to take the mystery out of visual phenomena, the magic will surely remain.

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Visual Literacy, Science Process Skills, and Children's Books

by
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Today's educators are faced with difficult instructional challenges. Schools throughout the nation are plagued with financial woes, multiple ethnic backgrounds of students, and children who suffer from neglect. Against this dreary backdrop teachers in elementary schools throughout the country are rising up to create learning environments that encourage children within a strong supportive social framework. Teachers and children are creating meaning together through shared opportunities for learning. Through cooperative learning groups children are learning to build their own meaning and understandings with the support of all in the class. Rather than creating dull chain links that are weakened by open space children are encouraged to build strong serpentine like links that are interconnected and strong. By learning to combine the links children begin to forge understandings that are rich in context and meaning.

Engaging students in meaningful activities becomes an ever increasing challenge in a world filled with competing images, bright colors, and an ever-quickening pace. Yet teachers find children responding favorably to opportunities to work together on problems, develop their own questions, and then find the answers to those questions. Providing opportunities to engage in meaningful reflective activity appears to outweigh faster, quicker, and brighter when it comes to learning.

A dramatic shift is taking place within elementary education. Teachers are shifting toward an integrated "whole" approach to instruction.

Spelling is placed within the context of the need to use the common spellings so that others will understand. Reading is for meaning and pleasure not just to get to the end of the read book with a list of new sight words. Mathematics is for solving problems that may be more practical in nature. Science is for helping develop understandings about the world around us. And the spoken word is for sharing our thoughts and ideas with others.

John Dewey (1916, p. 21-26) was certainly an advocate of this form of instruction. He encouraged teachers to plan instruction that involved interesting activities requiring physical activity, mental challenge, and collaboration. Dewey perceived the educational challenge as one requiring instruction that engaged the whole child. Kohl (as cited in Hassard, 1975, p. 57) defined wholeness as "being aware of and in harmony with the different components of one's existence." By providing holistic instruction we help children put learning in context and strengthen their understandings and progress toward becoming literate citizens.

According to Hassard (1985, p. 53) most teachers would agree that targeting the development of literate persons is a primary goal of education. "Literate persons have a substantial knowledge base with sufficient conceptual network and process skills to enable quick learning, logical thought and an appreciation of aesthetic values" (Hassard, 1985, p. 53). Developing cross content understandings helps to build the blocks necessary for broader literacies to develop. By combining literacies developed through visual literacy, science process skills, critical thinking/ problem-solving skills, and the reading of picture books professionals will make giant strides toward developing holistic literacy. Holistically literate persons are able to use skills from several disciplines at once to facilitate understandings, imagine new solutions to age-old problems, or create new images to communicate with others.

This discussion will center on the basic understandings that could be used to develop a foundation for holistic literacy. One way to establish this foundation for primary students is by developing understandings of the science process skills using the elements and vocabulary of visual literacy.

Developing a Sense of Primary Education

At the primary level there is a heavy emphasis on reading and writing skills. This is understandable since developing these communication skills are critical. However, all too often reading and writing are emphasized to the exclusion of other subject matter (Mechling and Oliver, 1983, p. 52). In an ever more rapidly changing highly technological society students need skills that are strong in the areas of science and critical thinking skills as well. By developing understandings of the science process skills as a post reading activity teachers can provide students with opportunities to reinforce their understandings of that they read, saw, and thought during the reading experience in a fresh new way. Fostering science process skills through visual literacy, using the shared reading experience is one way to include an emphasis in the importance of books while helping the child practice skills that cross into three distinct content areas: visual literacy, science, and language arts.

During the primary years it is of key importance to develop the building block type vocabulary within many disciplines. Without a basic understanding of key vocabulary words it is impossible to express one's thoughts and ideas with others. Developing verbal communication skills through discussion is an excellent way to reinforce language acquisition before children are comfortable writing. Children's will attempt to use the verbal vocabulary in written form once their verbal skills are well developed.

At the primary level children function on the concrete level. They must have opportunities to touch, look, and explore on their own if learning is to be meaningful. They need time to gain confidence in their understandings. Vygotsky (1986) called this the zone of proximal development. Newman, Griffin, and Cole (1989) called this the construction zone. This "zone" is the learning that surrounds conceptualization of an idea . Here the learner is afforded the opportunity to refine understandings within a safe learning environment. Children need to be actively involved in their own instruction. While the shared reading experience is passive, extending observations through hands-on activities after reading reinforces ideas brought about from the reading. This exploration also provides children time to creatively explore new ideas and viewpoints through the manipulation of tangible objects and intangible ideas.

Developing Visual Literacy

What is visual literacy? Visual literacy has many different interpretations depending upon the orientation of the writer or researcher. Perhaps for the elementary school level Braden and Hortin's definition is the most appropriate, simply because it is basic and non-threatening to the classroom teacher: "Visual literacy is (at least) the ability to understand and use images, including the ability to think, learn, and express oneself in terms of images" (1991, p. 1). This definition provides a broad zone of proximal development. For young children that wide developmental zone is ideal. Often a child's environment is so limited with regard to what is acceptable there is rarely an opportunity to stretch thinking within a safe margin. The development of visual literacy requires an understanding of the visual literacy vocabulary.

The vocabulary of visual elements can be easily understood by the primary child. It forms theinterconnecting links between other content literacies and allows students to move easily from one content area to another. It is the development of visual understandings combined with our ability to think and communicate that gives us our humanness. Within the animal kingdom many animals have highly developed visual instincts. They can see minute details that we would simply overlook. But is is the human ability to see think, and then communicate those thoughts and ideas that sets humans apart. Without developing visual acuity, critical thinking skills and a strong descriptive vocabulary educators run the risk of entrapping children with feelings they can't express. By providing them with the words and encouraging them to share their thoughts educators provide a vehicle for allowing children to explore not only their own thinking, but the thinking of others.

Building a basic visual literacy vocabulary strengthens the fundamentals that allow children to think critically and communicate with others. At the primary level children are often asked to tell what they "see" in a picture. Usually this question is followed by a description of what the child has observed. By encouraging children to discuss their observations, using a visual vocabulary, they progress toward more accurate language usage.

What visual literacy terminology would be appropriate? The vocabulary used during a discussion of the basic visual elements would be appropriate at the primary level. Dondis (1973, p. 21) provides a simple list of visual elements that teachers can easily understand and expand upon. His list of visual elements includes: line, color, shape, direction, texture, scale, and dimension. Each of these elements fits in nicely with science process skills. By using visual literacy terminology teachers and children will develop an understanding of the visual literacy language and develop ways if integrating that language into their other content areas.

Children need opportunities to explore the meanings of the visual elements. Lines can be bold or thin, straight edged or soft, solid, or dotted. Colors can affect feelings and attitudes. The selection of color by an artist may be symbolic of a deeper hidden meaning. Shapes are often discussed in the primary grades. Direction or point of view of an illustration or drawing is an important element for young children to understand. Developing an understanding of point of view may help young learners understand how manipulation of emotion can occur. Texture is a way for the artist to create a visually intriguing environment. Scale and dimension become important aspects when discussing scientific principles such as the universe or microorganisms.

Once children learn the vocabulary teachers must provide instances for students to practice using the terminology. "Visual literacy is a learner skill like writing and speaking" (Chu and Sanborn, 1991, p. 471). Far too often formal level thinking adults forget children need concrete experiences and lots of practice before they truly understand a concept. For the visual vocabulary to become part of the child's way of viewing the world it must be understood well enough to develop some transference. By providing practice through the shared reading experience using science process skills as the focal point of discussion students are required to recenter their thinking (McKim, 1972, p. 43) to communicate and manipulate their ideas.

John Stewig (cited in Chu and Sanborn, 1991, p. 473, 474, and 746) provides another aspect to developing visual literacy by discussing the importance of first evaluating the image's content, comparing and valuing it, and finally developing an appreciation or value for what one sees. Children need to discuss with their peers their perceptions regarding the pictures they see. Two observers may evaluate a picture differently while practicing a process skill exercise. Communication is something educators must foster if children are to be prepared for the world of work in the age of technology. Communication is a key element today in the world of adults. It is also a key element in science without developing the ability to communicate what has been observed or what has been researched is lost.

The Science Process Skills

The science process skills are the basic building blocks that form the core of scientific investigation. These fundamental skills tend to be attained by osmosis in most classrooms. Little is done to foster the understanding of the skill for the skill's sake. With little opportunity for practice transference doesn't take place. And yet, it is through science process skills that we gain the power to observe and make sense of life's events.

Many of the terms used to define the process skills are the same terms used within other content areas. The subtle impact of science upon all areas of study has gone largely unidentified. These skills have been referred to by Mechling and Oliver (1983, p. 45) more appropriately as "life skills." They form the fundamental core of critical thinking, literary evaluation, problem-solving, and mathematical manipulation. To place them solely within the science arena may seem too exclusive when they are so critical to life in general. However, science needs to be represented in the curriculum and all too often science is either avoided all together or taught as a highly sophisticated form of memorization. Children need to be exposed to the elements that make scientific investigation exciting, challenging, and motivating.

The process skills for primary students are generally accepted to include the following: observation, using numbers, communication, predicting, inference, and classification.

Students practice observation across the curriculum. What they need to understand is that the process of observation is the same, it is content and vocabulary that are different. Using numbers includes counting skills and graphing. Developing the ability to distinguish objects, count them, and depict the data is crucial for the development of sound science practices. Developing communication skills is extremely important for fostering clear communication so necessary within any field of study. Prediction is used to help shape activities, scientific experiments, and hypotheses. Inference deals with proposing various reasons for occurrences. Classification skills deal with various ways to group objects.

Each of these skills has increasing levels of sophistication which can be developed once fundamental understandings are established. Each of these skills is critical to the development of basic scientific investigation techniques. Without a firm understanding of these basic building blocks to scientific research students are only following directions given by a teacher on a piece of paper. It is through the thorough understanding of these skills that students can create their own investigations and ask questions that will foster creative solutions to the problems of the present as well as the future. Research shows that children who practice reading in conjunction with process skills are better thinkers (Crocker, 1986, 141-A). Rudnitsky and Hunt (1986, p. 463) noted children who practice observing patterns increased their ability to solve problems.

A current paradigm in science education is to emphasize Science/ Technology/ Society (S/T/S). Within this framework students are encouraged to explore life problems and the way in which science technology and society share an interdependence. Yager and McCormack (1989, p. 50) presented criteria for science education including creative thinking which they consider a necessary component to this model of instruction. Medawar (1984) shares with readers the importance of creative thought for the scientist. He contends that many major scientific discoveries were brought about as the result of mental imaging and creative thought. By providing children opportunities to explore science process skills through various means the creative process is encouraged.

Visual Thinking Skills

Robert McKim (1972) among others developed the concept that visual literacy is the arena in which we develop visual thinking skills. It is through visual thinking that the visual literacy vocabulary, principles and science process skills come together.

McKim extends the discussion of visual literacy well beyond the parameters of "art evolution" into the importance of visual thinking as a springboard for critical thinking. It is through mental imaging, manipulating ideas visually in the mind, doodling and sketching ideas as they are developed that really solidifies understandings. Visual thinking provides for the Gestalt "ah ha" understanding that serves as the enlightenment for developing ideas. Taking risks and creating unique solutions to difficult problems have historically propelled society into quantum leaps forward.

During his discussion of visual thinking McKim (1972, p. 43-48) discusses the concept of recentering one's vision. Here he sites artists, scientists and psychologists all of whom have stressed in their writings the importance of moving away from what appears to be the answer - what appears to be correct - only to find that once they've moved off center that they've discovered a more important issue or idea. This recentering of one's vision is critically important in today's world of instant assessment and quick production. Possessing the ability to look at a problem from many angles will be highly prized within the future market place. Providing the building blocks of recentering early will provide children with a tool to build knowledge bridges into the future. A learner recenters thinking when more obvious thoughts, ideas and orientations are brushed aside. When recentering has taken place the learner is freed to consider unusual ideas. By providing children the opportunity to recenter their thinking during the shared reading experience children have the opportunity to explore the process of recentering while practicing critical thinking and developing problem-solving skills.

The Shared Reading Experience

The shared reading experience using quality children's picture books is a highly regarded practice. Children have an opportunity to test their ideas, examine the thoughts of others and have their perceptions about the pleasures of reading reinforced. Regardless of age or even number of people in a room when a book is read orally something happens to the noise level ... it becomes extremely quiet! There is something inexplicable about having a book read aloud.

This experience provides children with a quiet or relaxed interactive time with literature. Often parents, grandparents or older children read orally during this time. Usually this is quiet "family" time full of feelings related to security and relaxation. This feeling can translate to the classroom as well. Teachers can provide a sense of warmth and nurturing thus providing a sense of security and comfort that may provide a safe environment for risk taking and creative thinking.

What is a Picture Book?

A picture book is a piece of literature carefully designed to incorporate text and pictures to convey the ideas of the author. "The purpose of a picture book, or any other book for that matter, is to communicate meaning" (Cullinan, 1981, p. 116). By helping children develop ways to describe what they see children are able to develop a deeper understanding of themselves.

Ironically, according to Lukens (1986, p. 27), picture books are often overlooked since the decoder is deceived into believing that a small brief book lacks substance. However pictures can provide a powerful background for telling a story. Children's picture books can be evaluated on two levels. First the book can be evaluated on its literary merit. There are quality books available that provide a rich use of descriptive language. In addition, according to Lukens

(1986, p. 26-27) books can be evaluated on visual criterion as well. It is on the visual basis that the Caldecott medal is awarded to an outstanding children's book each year.

Lacy (186, p. 16) contends that children's picture books provide the vehicle for helping children learn about life, themselves and about human nature. She contends that presenting information in as many formats as possible is crucial in helping children develop a sense of the thought processes adults take for granted.

Ideas for the Classroom

The following is a sample list of some of the ideas for blending visual literacy concepts with the development of science process skills through children's literature.

Base, Graeme. (1986). Animalia.. New York, NY: Harry N. Abrams, Incorporated.
Science: Observation and communication.
Visual Lit.: Color, pattern, texture.

Base, Graeme. (1986). The Eleventh Hour A Curious Mystery. New York, NY: Harry Abrams, Inc.
Science: Communication and observation.
Visual Lit.: Symbolism (for older children).

Ehlert, Lois. (1989). Color Zoo. New York, NY: J. B. Lippincott.
Science: Graphing.
Visual Lit.: Color and shape.

MacDonald, Suse. (1986). Alphabatics. New York, NY: Bradbury Press.
Science: Prediction and inference.
Visual Lit.: Color, line, shape, texture.

MacDonald, Suse and Oakes, Bill. (1988). Numblers. New York, NY: Dial Books for Young Readers.
Science: Prediction and inference.
Visual Lit.: Color, line, shape, texture.

Marshall, James. (1988). Goldilocks and the Three Bears. New York, NY: Dial Books for Young Readers.
Science: Classification.
Visual Lit.: Dimension.

Martin Jr., Bill and Carle, Eric. (1967). Brown Bear, Brown Bear. New York, NY: Henry Holt and Company.
Science: Graphing.
Visual Lit.: Color.

Minarik, Else Holmelund and Sendak, Maurice. (1961). Little Bear's Visit. New York, NY: Harper & Row, Publishers.
Science: Classification.
Visual Lit.: Dimension.

Sendak, Maurice, (1963). Where The Wild Things Are. New York, NY: Harper & Row, Publishers.
Science: Classification, observation, communication.
Visual Lit.: Line, pattern and texture.

Swann, Brian. (1988). A Basket Full of White Eggs. New York, NY: Orchard Books.
Science: Observation and

communication.
Visual Lit.: Line Pattern, color, shape, texture, rule of thirds.

Van Allsburg, Chris. (1979). The Garden of Abdul Gasazi. Boston, MA: Houghton Mifflin Company.
Science: Prediction and inference.
Visual Lit.: Color, line, perspective.

Van Allsburg, Chris. (1987). The Z Was Zapped.
Boston, MA: Houghton Mifflin Company.
Science: Observation communication and inference.
Visual Lit.: Color, line, texture, pattern, shape.

Summary

Educators must realize there is a new emphasis in the schools (Hassard, 1985, p. 53). The old orientation of instruction emphasized facts and concepts. The emerging orientation emphasizes "Literacy as it relates to creativity and the basic human needs and the needs of the planet's human population and survival" (Hassard, 1985, p. 53) Teachers must explore various ways of helping children develop a holistic approach to thinking and problem-solving if they are to be prepared to live in this highly technological world. By providing opportunities to integrate not only oral/aural skills but hands-on ex[eriences using vocabulary not usually associated with the reading of picture books educators have the opportunity to reinforce the perceptions yound children already have: Adults really do view the world in a holistic fashion integrating ideas from many content areas to solve a problem rather than in the fragmented and comparmentalized form that adults tend to use for instruction.

Developing visual understanding provides the texture, interest and detail to the process of developing the links that reach toward holistic literacy. Children need opportunities to build their understandings through practice in new situations that require an adaptive application.

The integrated approach to instruction provides teachers and children with opportunities to build meaningful learning links. Sharing books is a powerful instructional tool. By incorporating additional curricular information with the shared reading experience teachers are able to increase children's exposure to literature and reinforce valuable concepts that promote critical thinking and an appreciation for the highly visual world in which we live.

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Identifying the Visually Gifted: A Case Study

by

Barbara W. Fredette and Adrienne Hunter

This is a tale about an eight year old, Matthew, who loved to draw and design and make things. He did most of this work when he was finished with his regular school work and it was not seen by his teachers as being anything other than "Matt's Art Stuff". When adults do not know what children's drawings mean they call it art and thus relegate it to what is a minor area of endeavor in most schools. In this way it is also separated from recognition as an essentially intellectual effort.

Underachievement begins in the early grades (Whitmore, 1980). Most teachers are able to detect those children who are achieving below the expected grade level. But what about gifted children? Gifted children may be capable of achieving at a much higher level than is called for by the content of their age/grade level identification but the teacher may merely observe that they are 'good students' and not place higher expectations on them--or even know how to provide more sophisticated but developmentally appropriate learning experiences.

For this reason many schools have developed special programs for gifted students. The pattern of access varies but the initial identification of the student, by a teacher, or by the parents must be supported by concrete evidence--a major element of this evidence is an IQ score. In Matthew's case it was 128 which is 2 points below the 130 which is a general requirement. The law reads that IQ is just one criteria and, where it is below 130, multiple criteria may be used to give the child access to the gifted program.

The identification of 'other criteria' which are acceptable can be a real problem for children such as Matthew who exhibit a major part of their intellectual giftedness through visual processes and products. In allowing for multiple criteria there is little attention given to the fact that most people who are making decisions about access to gifted programs--and this includes the classroom teacher--do not know how to identify gifted visual problem solving. Many teachers (and administrators of gifted programs) are incapable of recognizing the extent of intellectual (cognitive) giftedness in the visual products of their students. In Matthew's case the people who controlled the 'gates' were not, at the outset, willing to accept his drawings and constructions as evidence of intellectual giftedness.

This was a problem for Matthew. But his mother, an art teacher, knew that her son was gifted and with a great deal of effort sought to break down the bureaucratic barriers. She requested a hearing. In preparation for the hearing she asked to review the test protocols for the WISC-III which had been administered to Matthew. A major factor in denying Matthew access to the gifted program was the score he received on this test.

When she reviewed the test protocol she discovered that the test had not been properly administered. The school psychologist had administered five (5) Verbal Subtests, but had only administered four (4) Performance Subtests: Picture Completion, Picture Arrangement, Coding, and Block Design. The fifth subtest, the Object Assembly, was prorated based upon the average of Matthew's verbal subtest scaled scores. Matthew had achieved the maximum score on the block design test and it was the opinion of several psychologists who were consulted about this matter that the score of 128 was inaccurate. They suggested that, considering Matthew's demonstrated visual and spatial ability, his IQ score should have been about 6 points higher had the full test been given.

If the test had been administered correctly Matthew would have been qualified for the gifted program but that would not necessarily have resulted in his receiving the type of education necessary for the development of his full potential as gifted in visual/spatial intellect. He probably would have received the same gifted education as the other children who are channeled along the verbal and/or mathematics route. Matthew is an 'A' student but he needs more than the usual accelerated and enrichment activities that are available in the special gifted program. His unique giftedness is observable in the many images he produces, images which reflect a unique spatially cognizant intellect. Images which, unfortunately, many adults, especially teachers, see only as Matt's "art thing".

Characteristics of Giftedness

There are a number of commonly accepted characteristics of gifted children (Golembiewski, 1991). These are identified as cognitive characteristics, personality characteristics and the characteristics of creative children. Examples of Matthew's work--done over a 2 month period of time--exemplify each of the characteristics. A major problem for Matthew was that the people who worked with him--his teachers--did not recognize these visual processes and products as evidence of his intellectual giftedness.

Note: The examples of Matthew's work which represent these characteristics are available as slides which represent a guided visual tour of Matthew's thought processes. However for the purposes of presenting the material in a paper form descriptions are substituted. A few visual examples are included in a much reduced size.

Advanced Ability to Manipulate Materials

Matthew created a game and a gameboard on which to play it. The board was made of construction paper with which Matt constructed a bridge with a trapdoor to fall through and a treasure which was hidden in a central circular form which could be raised and lowered. He worked out all of the necessary problems to make the paper do what he wished it to do. He has also spent a great deal of time making folded paper airplanes each of which is designed to do something different. Matt is an advanced-level Origami enthusiast.

Unusual Ability to Remember

A great deal of visual memory is called upon when a child creates a picture.The more details which are in the picture the more memory is being shown. Matt's pictures are filled with detail and with imaginative recombination of remembered aspects of things. It is hard for teachers, even art teachers, to recognize the depth of meanings representing the vast memory store that is being displayed in his visual products.

Deep Levels of Concentration

Building with Legos, Constructs, Blocks, Tinkertoys, and other manipulatives engrosses Matthew for hours at a time, daily. In fact, his mother tells the story about the time Matt misbehaved and had his "Lego Time" restricted. (He doesn't watch television enough to lose TV privileges.)

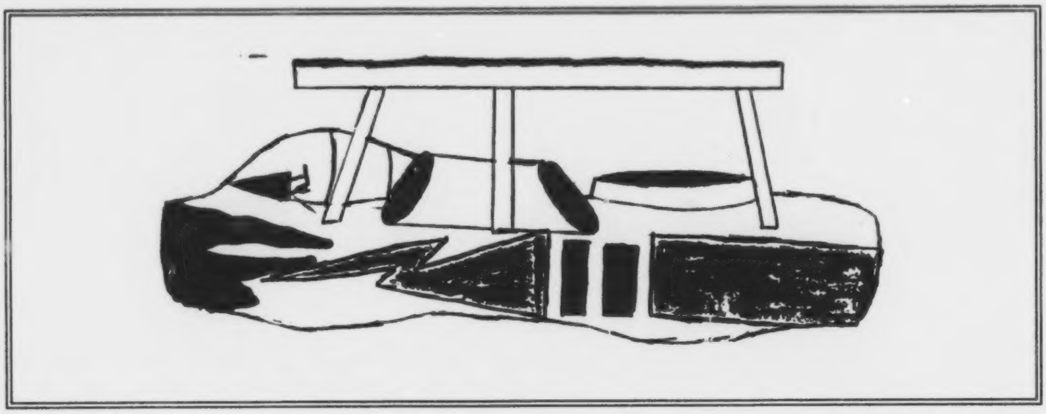
Sees Generalizations

As Matthew examines cause/effect relationships, explores options, and makes informed decisions, his creative problem solving skills generalize into many other aspects of his life. Following a drawing expedition to the Egyptian exhibit at the museum, Matthew's drawings depicted Horis with his feet and clothing re-designed, but still maintaining the distinctive Egyptian art style. Horis eventually finds himself drawn in the future (present) and as Matthew puts it, "He's back, and He's MAD! He's mad at what we are doing with the world!"

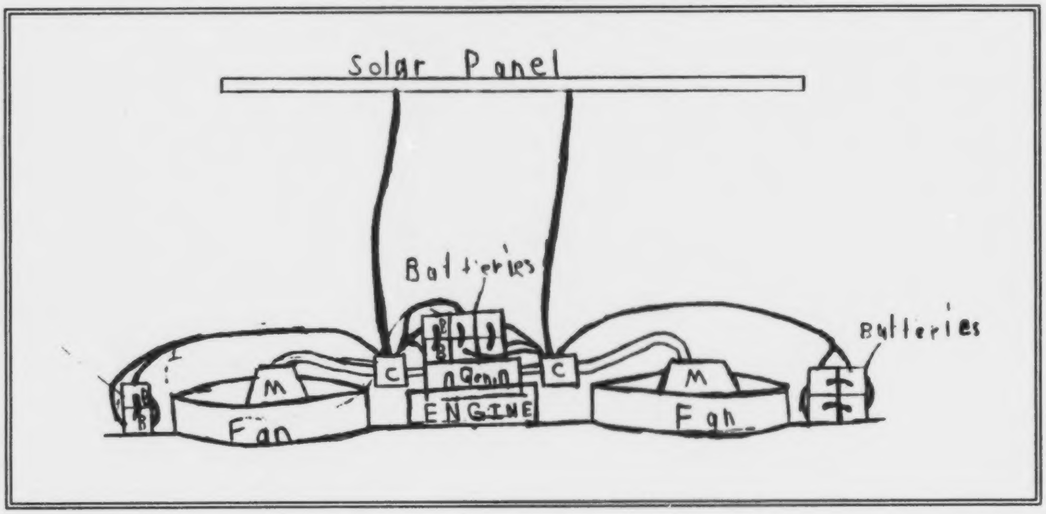
Large Storehouse of Information

Showing his intense concern with how and why things work, Matthew pulls from an exceptionally large specialized storehouse of information when he designs, evaluates, and modifies his ideas. He is especially skilled at designing paper airplanes where his knowledge of aerodynamics is evident as he is able to modify his designs to achieve desired performance. Each plane he creates is designed to do something special--and they work!!!

Another design effort he called The Solar Power Hover Car - "It gets you to work on time and doesn't pollute the air". Multiple sketches showed how this went from a design concept to a refined idea. The S.P.H.C. is powered by solar electricity, and when the sun isn't shining, it is run by natural gas. (See final design illustrated below.)



OUTSIDE



INSIDE

Varied Interests

Matthew's interests run the gamut from art, science, history, world cultures, to sports and poetry. He is a child for whom there are not enough hours in the day. Constantly aware of the world around him, Matthew follows current events with interest and often reflects his points of view in his artwork. He is as interested in the past and the future as he is in the present. His airplane drawings include pre-World War II bi-planes as well as futuristic space vehicles.

Exceptionally Curious

To satisfy his constantly inquiring mind, Matthew utilizes a variety of resources from observation, reading and asking questions to hands-on experimentation. In addition to the challenge of solving problems, Matthew enjoys creating challenges for others to solve via the mazes and board games he has designed. (See maze illustrations.)

Personality Characteristics

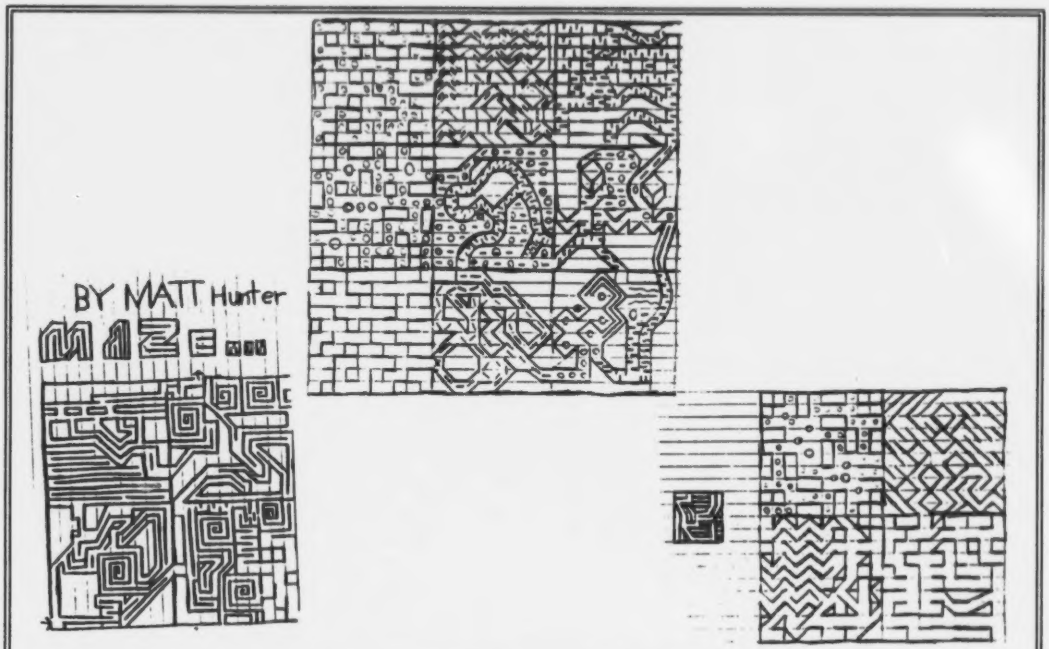
Sensitivity to Themselves, Others and Their Environment

When Matthew was only three years old, his mother was very ill following chemotherapy. Matthew greeted his mother on one of her worst days with, "It's a good day to get up Mommy, the sun is shining!" Matthew has a keen understanding of his own needs as well as those of the people around him. Of his own initiative, Matt donates his old toys to shelters when he feels his room is "too crowded" or he has out-grown a particular toy.

Matthew's concern for world peace and his environment can be seen in his artwork. A particularly poignant drawing "Toxo-Vipers" shows a battle with the bad guys that begins in a chemical plant and moves outside the plant amid toxic chemical eruptions.

Perfection

Striving for perfection, Matthew will rework an idea over and over until he has accomplished his goal. While he is unquestionably patient with and helpful to others less able, he is impatient with his own inability to do something which he feels he should be capable of doing faster, easier, or better.



MATTHEW'S MAZES

Matthew has a keen sense of proportion and spatial relationships. While working on a project with his class, Matt was very agitated over the fact that the people made as a result of directions by the teacher were larger than the buildings. When he called this fact to the attention of his teacher, he was told "it didn't matter". This was an insult to Matthew's sense of proportion, and his teacher lost credibility in Matt's eyes. His parents began to notice that Matthew would selectively "tune-out" his teacher.

Resourcefulness

Recognizing and exercising options comes naturally to Matthew. Never at a loss for ideas, Matthew will improvise and adapt as needed. When building with his blocks, if he doesn't have enough of a particular type, he will use a variety and build a multi-media unit. Recycling is a way of life for Matthew, and trash becomes treasure.

Ability to Learn Quickly

The third grade math class was learning perimeters, but Matthew was teaching himself three-dimensional design. In the span of only a month, Matthew's drawings illustrate the evolution of his thought process as he begins with a 3-dimensional doodle on graph paper, moves to design a 3-dimension house, uses his newfound knowledge in a more abstract "Escheresque" theme, and finally emerges with a sophisticated 3-dimensional mansion, without benefit of any instruction in perspective or three-dimensional design.

Leadership Ability

Despite the fact that Matthew is a rather quiet, understated child, he is a natural born leader. Other children look to Matthew for leadership. He utilizes good organizational skills without controlling. He also possesses a natural inclination towards teaching. As an advanced Origami folder, Matthew was invited to join the adult Origami Club to assist beginner-level adult members.

Creative Characteristics

Above Average Ability

Academically, Matthew is an A student, scoring in the top 1% on national standardized tests. Matthew frequently takes his work further than that which is expected or required. He sets his own goals in addition to those goals set for him.

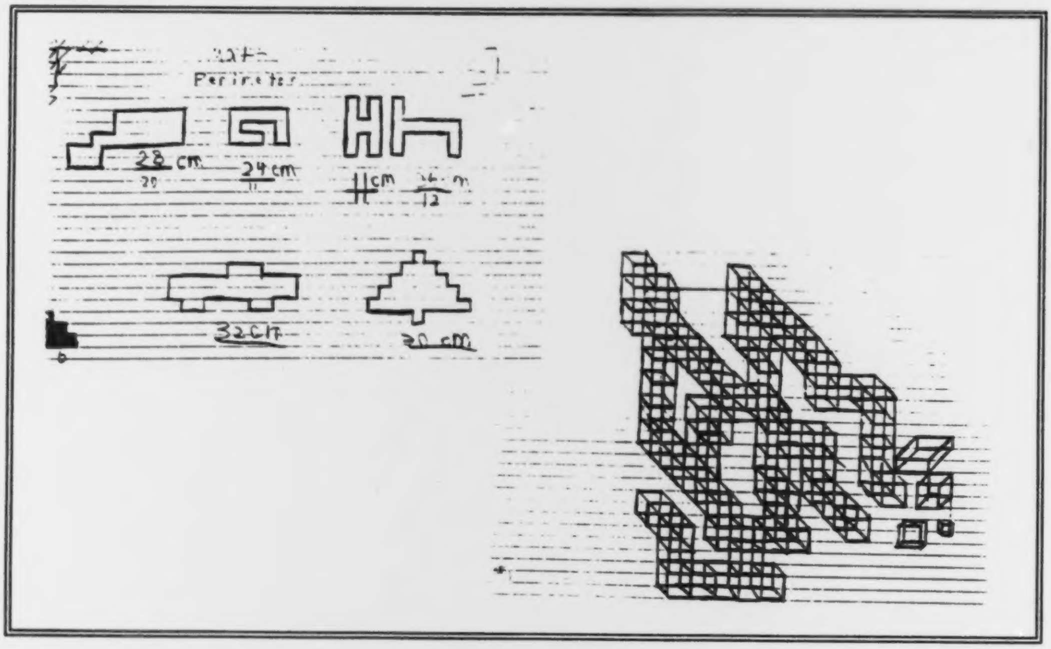
Natural Drive to Explore Ideas

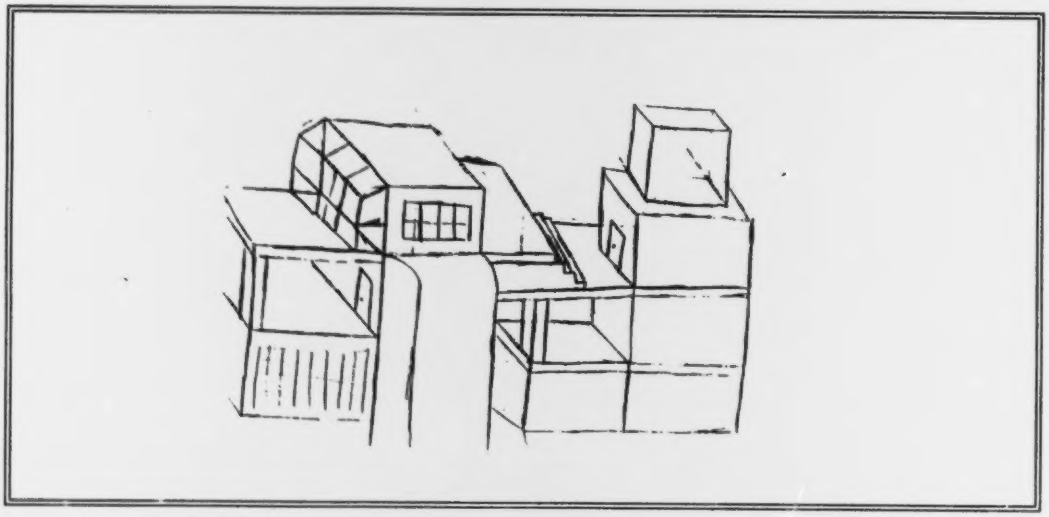
Matthew's natural drive to explore ideas is exemplified in "Sharks That Attack" which began as a standard enrichment assignment. The requirement to research a topic and write a report·grew into a unique journey of the mind. From research to writing, Matthew moved on to shark illustrations. The illustrations of natural sharks that attack evolved into mechanical sharks that attack. Swimming with the natural shark, a mechanical shark or submarine shark is shown attacking a ship. On the reverse side of the drawing, the interior of the ship is shown filling up with water, compartment by compartment, along with the damaging torpedo lodged in the ship.

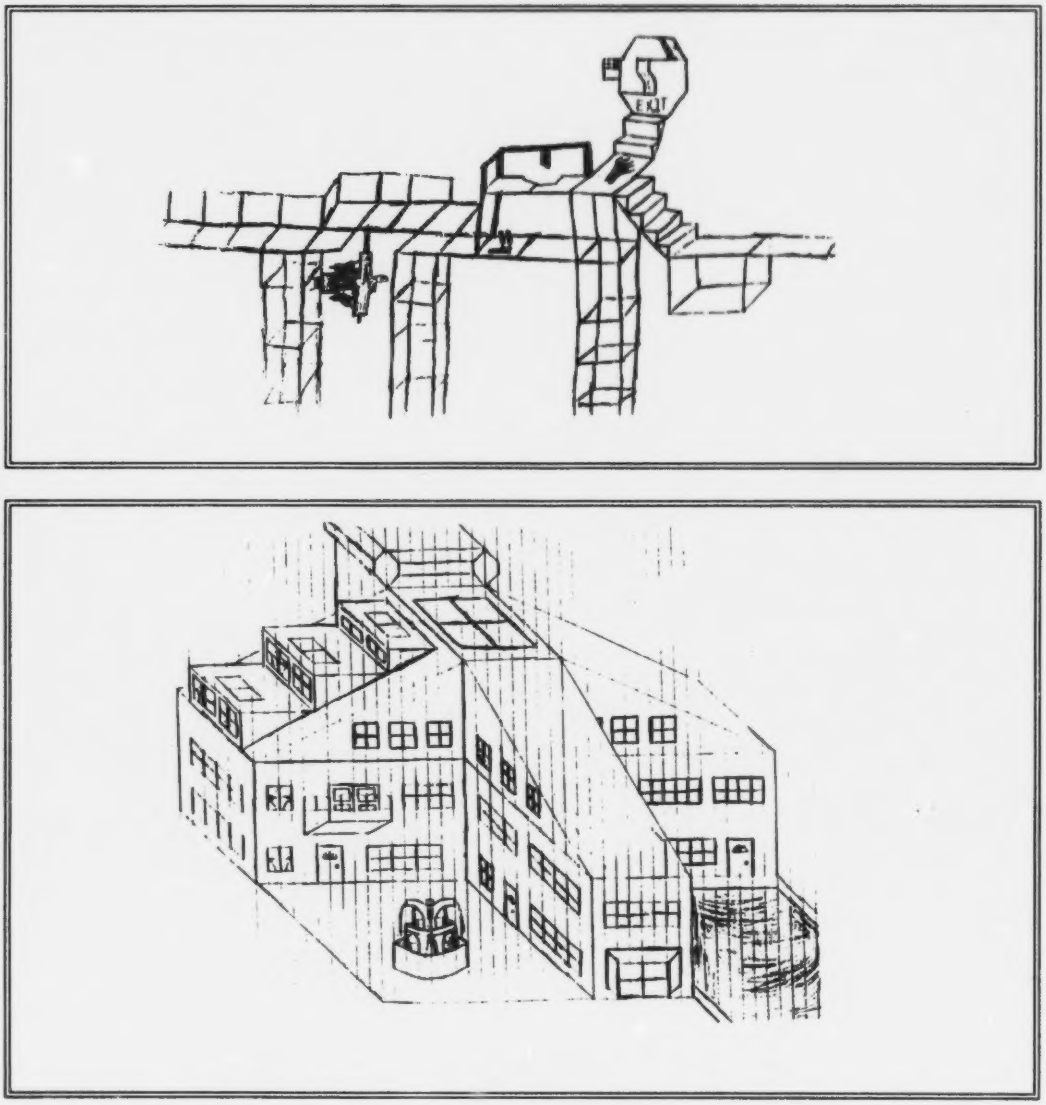
Ability to See Things as a Whole

As a very young child, Matthew was able not only to read schematic diagrams for assembly, but was also visually able to detect any errors in the instructions.

A particularly unique attribute of Matthew's drawings is his attention to not only the exterior view of his designs, but also the interior views and working mechanisms. Additionally, he offers us front views, back views and aerial views in his design series. He pays particular attention to details and spatial relationships in all of his drawings.







Drawing series representing self-taught perspective

Challenging the Conventional

Although he values friendship, Matthew is not concerned by what other people think about the worlds he imagines and creates on paper or in three dimensions. He is not swayed by peer pressure as he pursues his own interests. While at times this sets Matthew apart from his peers, he appears to receive respect as his talents are recognized.

Playfulness, High Energy and Restless in Mind and Body

Matthew has a very close relationship with his teenage sister. She serves as his mentor and his ideal. To her dismay, she also serves as the object of his devilment. From flying his helicopters into tangle range of her long hair, to blowing up her block-built structures, he knows just how far he can go to annoy her without retribution.

His mind a constant whirl of thought, Matthew never leaves home without his drawing tools. Even for short trips to the grocery store, Matthew is busy making sketches of ideas as he thinks of them. In this, as in all of the other behaviors just described, Matthew is a fine example of a young gifted student and one who is exceptionally gifted in visual/spatial intelligence.

This story about Matthew has a good ending--at least the first episode. Due to his Mother's extensive efforts which included obtaining letters of recommendation from persons who are knowledgeable about children's development in graphic expression, Matthew has been accepted into the gifted program. This may be good for other children as well because the criteria for admission to gifted education in Pittsburgh Public Schools has been expanded to include visual and spatial intellect (in addition to mathematical and verbal intellect evident in standardized tests).

An Individualized Educational Program has been written for Matthew. His IEP is to includes, in addition to accelerated and enrichment activities, the opportunity to develop his interests in architecture, engineering and design. He will be instructed in these areas by various contracted artists. Further:

> "He will be given opportunities to develop visual/spatial intelligence in content areas. His higher level thinking skills will be developed. He will have opportunities to express in visual symbols and images concepts learned in subject areas. He will have input in developing special projects that coordinate with the curriculum. He will also have additional opportunities for self expression through art in order to use his creative ability with time to develop specific skills within a variety of art media."

In order to achieve the IEP the curriculum must also be changed to meet his needs. Woolslayer Gifted Center does not have a resident art teacher, not even an itinerant one--practicing artists are occasionally contracted to visit. It is in the plan that Matthew will be paired with an architect (shadowing) but it is unclear how such a person will be identified and it is also unclear what the role of the person will be and whether or not he/she will be suitable for this important pairing.

In general it has become apparent that success in being identified as gifted doesn't end the problem for Matthew. The major problem still remains--a lack of ability on the part of adults working with Matthew to recognize this type of giftedness and to nurture it within the context of the educational experiences they provide for him. Matthew enjoys going to the Woolslair Gifted Center one day a week but the other four days in his regular classes are falling short of the IEP. Matthew's one art class a week is scheduled on the day he goes out to the Gifted Center so Matthew doesn't have any art classes at all (there is no art teacher at the gifted center). His social studies teacher gave him pink construction paper and told him to "draw continents and peninsulas on it. His science teacher told him to draw himself wearing safety goggles. Matt was asked, "Were you supposed to design safety goggles?". Matt replied, "No, just draw the ones we wear."

In conclusion we must consider what changes must occur so that visually gifted students like Matthew are not denied access to an education which will enable them to become the much needed designers of our future. "This art thing" is how Matthew's giftedness was referred to by his content teachers. These content (Math, Social Studies, Science etc.) teachers are unaware of how to imaginatively and creatively utilize Matthew's visual designing talents.

We need to educate or reeducate teachers so that they can recognize in children's visual products the work of a high level intellect. We need more teachers who can use visual products as assessment tools and who recognize in the visual products of students evidence of high level thinking processes. We need teachers who can provide appropriate learning experiences for the visually gifted. They should realize that it is not enough to suggest that children illustrate a story they've written, if there's enough time. Perhaps the illustration should not be an 'afterthought', perhaps it should be the 'first thought'. Why not have children draw a story–then for people who can't read it--tape or write a narration to accompany the drawing.

What is needed is a re-thinking of the ways in which graphic ideation is encouraged (discouraged may be more appropriate). What is needed is a curriculum that appreciates the gifted visual thinker and uses developmentally appropriate activities that are challenging. An effective curriculum for the education of the visually gifted would not merely add visual activities as superficial add-ons. (As Elkind (1987) argued) children should not be made to fit into schools but schools need to fit children.

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Synetics and Imagery: Developing Creative Thinking Through Images

by
Richard Couch

This paper will describe synectics: what it is, the steps a facilitator or teacher would use in the process, the connection of synectics to visual literacy, and how synectics can be used in a school curriculum. It is worthwhile to think of synectics as a tool in the search for creative problem solving strategies or in the development of more creative products.

Fog

The fog comes
on little cat feet.
It sits looking
over the harbor and city
on silent haunches
and then moves on.
-Carl Sandburg
(in Joyce, et. al, 1992)

What is Synectics?

Cat feet and fog are very different things, but the mental image created by Carl Sandburg helps the reader to understand both the cat and the fog in a surprising and delightful way. Synectics is an approach to creative thinking developed by William J. J. Gordan and his associates (1961). It comes from the Greek term meaning "understanding together that which is apparently different" (Gunter, et al., 1990). Synectics is a group process which allows each individual to develop "insight" into a topic or concept. The main tool for developing this "insight" is analogies or metaphors.

In the use of synectics, metaphor is broadly defined to include all figures of metaphorical language, e.g. simile, personification, oxymoron. One of the common strategies in creative problem solving has been to "relook" at common things in our world in order to find creative solutions. For example, the person who invented VELCRO was pulling burrs from his dog when he discovered that the way the burr attached was through a simple hook on the end of each spine. Thus the hook and eye fastener known as VELCRO was developed. The use of synectics leads us into a world of slightly illogical discovery. Unlike most tasks in our lives which require logical, sequential thinking, many seemingly impossible tasks may require a "relook."

Conventional View of Creativity versus Synectics

Synectics helps us challenge conventional views about creativity. One view is that creativity is only used for special problems; however, creativity should be used in everyday activities. Creativity is not simply the great works of artists or musicians. It is part of our everyday lives. Gordon's "... model is designed to increase problem- solving capacity, creative expression, empathy, and insight into social relations" (Joyce, et al., 1992, p. 219). The meaning of some ideas or concepts can be enhanced by allowing us to "see" things in a different and more meaningful way. A second view of creativity is that it is intensely personal. Gordon suggested that groups as well as individuals can generate products which are creative.

Gordon believes that creativity can be developed through the development of new mental patterns. Part of the development of these new mental patterns involves asking the participant in the synectics process to draw upon emotions. An interplay between nonrational thoughts, i.e. emotions, allows for originality in developing new ideas. Gordon believes that intellect or logic is important but can stifle creativity. Constructively controlling the irrational and emotional responses of an individual is the goal of synectics (Joyce, et al., 1992).

Synectics helps to touch or the visceral core of our being. By controlling the process through analogy, the individual can develop new visions, either through imagery, nonverbal behavior, visual representations, or verbally. The author's experience has been that the user of synectics creates very vivid **visual images** as they apply the process. The images are very idiosyncratic and, therefore, more meaningful, which helps the user to create new insight into the concept or into the problem being scrutinized.

The Steps in the Synectics Model

Three forms of analogy are stressed in the synectics model: 1) direct analogy, 2) personal analogy, and 3) symbolic analogy.

The teacher begins by asking students to describe a topic with which they are familiar, either in small group discussions or by individually writing a paragraph. In the second phase of the model, the students form a direct analogy between the descriptive words on the board, (Step 1) and words from an apparently unrelated category. The teacher may ask the students to think of a food which reminds them of the words they generated in Step 1. A direct analogy is set up to make comparisons between two objects, ideas or concepts. How is democracy like a pizza?

Each of the students suggestions is listed on the board or overhead and each person is encouraged to explain why he or she chose their particular analogy. This part of the step is important for clarification of student thinking and as an informal diagnosis of an individual student's creative thinking. It is extremely important to be nonjudgmental about responses and to keep other students from being judgmental.

The facilitator's (teacher) job is to record the responses and to ask the students to generate reasons for each choice. These two simple guidelines are important at each step of the synectics model. When the teacher feels that everyone has had an opportunity to participate and the class is ready, the students vote on one particular analogy that they prefer. The teacher then asks the students to pursue this analogy in the next step of the synectics model.

The third step involves asking the learners to view reality from the perspective of the metaphorical object that they have just selected. Students are asked to tell how it feels to be this object, and then their reactions are listed on the board. Each person is encouraged to explain why he or she had a particular feeling. Personal analogy invites students to become a part of the problem to be solved or the image that is being explored. How does it feel to be a computer? What is it like to be a dandelion? The goal of this step is empathy.

The fourth step is to identify compressed conflicts. The teacher or facilitator asks the students to examine the list of words that they created in the last step and find word pairs that seem to fight each other. This symbolic analogy, or compressed conflict, involves descriptions that appear to be contradictory but are actually creative insight, a kind of oxymoron, e.g. "open secret," "deafening silence."

The fifth step is to create a new direct analogy. Once you have chosen a compressed conflict, the students will then generate a list of examples of animals or machines or foods which have the same compressed conflict.

The final step is to reexamine the original topic. The class takes the last analogy and compares it to the original topic. No mention is made of the original subject until this last step. The purpose is to get away from the original topic, step by step. The class will rediscover the original topic with much more insight using vivid and rich imagery which has germinated during the process. When asking them to write about the original topic, the students may use any of the analogies generated during the process.

What follows is a brief description of each step of the process:

Steps

1. Describe the topic:

Select a subject to explore with the class. This may be from any discipline. It may be a character from a novel or a concept such as democracy. It may be a problem which needs to be solved. Students generate descriptions of the content in writing, orally, or perhaps in drawings. The teacher lists the words or phrases on the board or overhead and also asks students why they chose that word or phrase.

2. Create direct analogies:

Select a category - plant, machine, food, animal - and have students generate a list from that category, foods for example. This list would have the same characteristics as those words listed in Step 1. Be sure to ask why they chose those particular foods. Ask them to generate vivid mental images. Mental images are powerful tools in the process.

3. Describe personal analogies:

Have students select one of the direct analogies and create personal analogies. Students "become" the object they choose and then describe what it feels like to be that object. They develop an empathy for that object.

4. Identify compressed conflicts:

Ask the students to pair words which seem to fight each other. Always have the students explain why they chose the words which conflict. Then have the students choose one by voting.

5. Create a new direct analogy:

Choose one of the compressed conflict pairs, then ask the students to create a different direct analogy by selecting something that is described by the paired words (a plant, a fruit, an animal, a song, etc.).

6. Reexamine the original topic:

Return to the original idea or problem so that the student may produce a product or description that utilizes the ideas generated in the process. They may concentrate on the final analogy or use analogies created in the other four steps (Gunter, et al., 1990).

Why Synectics?

Gordon looks at synectics as a method of developing creative responses to problem solving or production. He encourages creativity and uses group cohesion to raise the energy level of the group in order to develop a thinking community of learners. A significant use of this model is the generative power of a variety of perspectives for viewing topics. However, rarely do the advocates of this model discuss its merits for the retention of information. The use of commonly accepted analogies, or universally accepted knowledge to frame new knowledge, has been shown to be helpful in the retention of new information. The schema theory is based on the premise that students must establish a prerequisite knowledge base before any long-term, meaningful learning can take place. Using synectics to help students generate a knowledge base can help them also retain information. By creating a visual imagery, thus using existing schemata, the student will enhance long term memory. Visual imagery has been shown to be a powerful learning tool. The potential uses of the synectics model in the curriculum are numerous.

The use of synectics in the writing process has been shown to be very helpful when it comes to generating expository and creative writing. It can help students develop a personal style of writing. Additionally, by developing a creative community of learners the synectics process allows for a group of serious peers who can help the writer to become better through peer feedback. The "relook" of a familiar topic can enhance one's long term memory and ability be creative.

The model is helpful in exploring social and disciplinary problems within a classroom or a team. The use of metaphor creates distance, that is, the process allows the students to escape the often occurring finger pointing; it is less threatening. The personal analogy phase allows for self-examination and insight.

In the creative problem solving domain, the most important thing that the synectics model can do is to help the users to break existing mind sets and to relook at the problem. Concepts such as democracy, prejudice, and values are difficult to internalize because we cannot see them. They often rely on concrete, visual image examples to define them, e.g. the United States as a democracy, the picture of the KKK as an example of prejudice, or a mother, father and children as a picture of family. However, synectics is a way to make the familiar different and to gain new insights or to deepen our understanding of the concept. The use of visual images to establish a mindset is common in the advertising business. The use of synectics can help us see our world differently. Any time we can "relook" at our world we are enhancing our visual literacy.

Synectics can be used with all ages, although very young students find it difficult. The model works well with students who withdraw from traditional methods of teaching and learning. The renewal which synectics brings to the classroom often occurs because it rewards creative responses. It also works with more advanced students who are always rewarded for the "right" answer and very structured thinking. It makes them think divergently and creatively rather than convergently and didactically.

Synectics has been developed to help increase the creativity of individuals and to allow them to develop new insights into problems, to reexamine their world. It is the author's hope that the reader will try it with students or in groups of business people to produce new products. The author knows of several instances where the technique is used to enhance design teams. In this visual world, this world which is constantly changing and in which we need creative solutions to serious problems, we frequently need to relook at our world. Synectics can help us to relook and to find creative solutions.

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Nonverbal Language and Its Implications for Teachers

by

Richard Couch

What nonverbal messages do teachers send to students? What do students infer from nonverbal behaviors - correctly or incorrectly - about their teachers? Is he a warm, caring person? Is she empathetic? Is he enthusiastic? Does she love her work? Attitudes, values, motives and intentions can be evaluated based on nonverbal behaviors. Body language is often more sincere and honest than what comes out of a person's mouth. Salespeople have known this for years: "dress for success," "firm handshake," "stand up straight and look the client in the eye." Teachers, similarly, can benefit from a clear understanding of nonverbal communication. After all, they also have something to sell to their students. This article addresses three types of nonverbal communication, the implications and the relevance of each for classroom teachers.

Two Channels of Communication

There are two channels of human communication: verbal and nonverbal. Our nonverbal messages are transmitted without spoken words or in addition to spoken words. There are three distinct categories of nonverbal communication: proxemics, coverbal behavior, and paralanguage. See Figure 1.

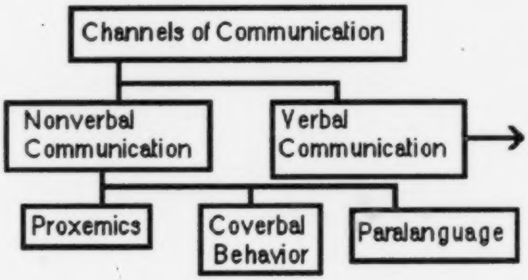

Figure 1. Communication Channels

Proxemics describes the physical arrangement of space within a classroom and the space we allow between ourselves and others, i.e. interpersonal space. Coverbal behavior describes physical movement such as gestures, facial expressions, eye gaze, directness of body orientation, and posture. Paralanguage is a way of classifying verbal nonlanguage such as voice tone, rate of speech, pauses, disfluencies such as "um," "uh," "er," "o.k.," "like," and nonlanguage sounds such as giggles and yawns (Kauchak and Eggen, 1989).

No matter what we may be verbally expressing in a given situation, our body language will communicate our attitudes, feelings and other inferential messages. While verbal communication helps us respond to abstract ideas and concepts, nonverbal communication sends a much more concrete message.

The credibility of a message was studied by Mehrabian and Ferris (1967). They found that only seven percent (7%) of a message's credibility was communicated through words, that is, verbal communication. However, 38% was communicated by the tone, pitch, variation, of the voice which is paralanguage. The last 55% of the credibility of the message was transmitted via coverbal behavior. In other words, the message sent via gestures, eye contact, posture, facial expressions, and so forth is eight times more credible than the verbal message.

We have all been in a social situation where we are talking to someone and that person keeps looking at another group of people while talking to us. No matter what that person says (verbally), she cannot convince us that she would rather be here than over there. Her nonverbal language sends a different message than her verbal language. This is called incongruent communication. It often is played out in the classroom as, "do as I say not as I do." A teacher can say to his students, " I love you guys." or "I respect everyone in this room." However, if the nonverbal language does not communicate the same message, then the students will clearly understand the hypocracy of the words. Before discussing the implications of nonverbal communications to the classroom teachers, it is important to understand each of the nonverbal channels of communications and their potential effects in the classroom.

Proxemics

An understanding of proxemics can help the teacher in several ways. Teachers often utilize the arrangement of the classroom and their location within the classroom as a teaching tool.

Teachers sometimes physically separate themselves from the class with a negative effect. By setting up a concrete barrier, either a desk or a podium, between themselves and the students, teachers are sending two nonverbal messages. One message is that I am in charge here; this is not a democracy. The second message is that I have the knowledge and I give it out at my whim. The teacher may not even be aware of the messages he is sending. But neither message is conducive to building a good learning community.

Another example of proxemics which can help teachers in their relationship to students is the arrangement of the student chairs. If the teacher is included in a circle at the same eye level, that is, she is included as a member of the group by sitting in the circle with students, then students may infer that the teacher is also learning, therefore, is part of a learning community. This is not only a good message to be sending to the students, it also helps the teacher become a facilitator of learning rather than a dispenser of information.

Another example of the use of proxemics for the teacher is the location of the teacher when helping students do seatwork. If the teacher stands, hovering over a student, that sends a completely different nonverbal message than crouching down to the student's eye-level to help. The first position is one of power; the second is one of collaboration.

Finally, the knowledge of proxemics can help a teacher in the management of classroom discipline. If two students are talking in the back of the room, it is a much more powerful message to move to the location of the disturbance than to yell at the students from across the room or from a seated position at your desk. Even walking to a position which is very close and may seem to be invading a student's space can help solve some classroom management problems.

Some-times a touch will indicate a feeling of warmth, however, the teacher must be careful about touching students - know your students before touching them. Be proactive in the nonverbal messages that you send. In other words, being able to use the space in the classroom and your location in that space to your advantage, can eliminate a lot of discipline problems in the classroom.

Coverbal Behavior

Coverbal behaviors are the nonverbal messages conveyed by eye contact, gestures, facial expression and posture. When a teacher leans on a podium and rests his chin on his palm, the nonverbal message being sent to a roomful of students is that the teacher is bored with the subject matter or is not very excited about his students. Eye contact can demonstrate a sincere desire to communicate with students. It helps to establish a relationship with the student on a personal level. If you look at students when you ask questions, you can also get feedback on their understanding - the light is either on or off. Making eye contact can also send a meaningful message to those students who are talking in the back of the room. Perhaps making eye contact is enough to stop idle chatter. On the other hand, if you say something with your back to the student, that sends a different message, it indicates that you are not very serious about getting them to stop talking.

Coverbal behavior can send negative messages as well. Imagine the following scene: you are sitting at your desk, a student comes up to you, you glance up and continue to work ignoring their need to talk to you. That nonverbal communication sends a clear message to the student that what you are doing is more important. Simply recognizing the student and telling him that you will be with him in a minute can send a much more positive message. Coverbal language can be beneficial or it can be a problem for teachers if they are unaware of the implications of their behavior.

Gestures can convey a love of the students and a love of the content. Enthusiastic teachers display many of the coverbal behaviors. Enthusiasm will be elaborated on in a following section. One of the most obvious nonverbal messages sent by students when they are tired or bored is chin on hand, slouched in chair, or arms folded on chest, scowling. By being aware of these signals we can learn to vary teaching strategies which allow us to reach more students more often.

Paralanguage

Although considered nonverbal communication, paralanguage can send powerful messages. The constant use of "um" or "er" or "uh" can mean many things. It can mean I'm nervous or I'm unprepared or I'm ill-suited for this task. Students can infer from this nonverbal behavior that the teacher does not have a good command of the English language and even that the teacher uses colloquialisms to be more like the students. We have all had teachers whose paralanguage is distracting. Many stories have been told through the years about students who count the number of "uh's" just to stay awake in a class. An understanding of paralanguage is extremely important. Although disfluencies are very difficult to overcome, these nonverbal sounds can be powerful indicators of messages you may not want the students to receive.

The first step in overcoming disfluencies is to be aware that you utter them. Further steps include: get more experience presenting to a group so that you are not as nervous and will avoid saying "uh" or "er." Always be prepared so that you don't indicate through paralanguage that you are not prepared. Avoid colloquialisms. And finally, avoid using a constant time filler like "o.k." or "like."

Implications of Nonverbal Language

The implications of nonverbal behavior are important to classroom teachers. Students can infer from this nonverbal language that a teacher is warm and caring, empathetic, and enthusiastic.

Additionally, by modeling certain nonverbal behaviors teachers can demonstrate the code of conduct they expect in their classrooms. Finally, nonverbal language can indicate the teacher's expectations for her students.

Warmth, Caring and Empathy

Warmth and caring is the teacher's ability to demonstrate he or she cares about the student as a person. Students don't like being considered a number any more than do the rest of us. An honest concern for students is demonstrated in many nonverbal as well as verbal ways. A smile, a nod of the head, a wink, a hug, a pat on the back, a "high five" all indicate that the teacher cares about his or her students. Honesty is the key. As many actors know, the action must come from the inside. That is to say, the motivation comes from the sincere belief of the character. Teachers cannot "fake it" when it comes to caring and providing warmth for their students. They shouldn't even try.

Empathy is that skill which allows a teacher to put himself or herself in the student's position. Empathy can be demonstrated in nonverbal ways. However, each of these teacher attributes is highly individualistic and it is impossible to give a formula for demonstrating each nonverbally.

Classroom management can be the most fertile ground for nonverbal communication. Being empathetic can mean a variety of things including understanding that you were a student once yourself. The opposite of the empathetic behavior is the adversarial behavior that many teachers establish. In this case the teacher's nonverbal behavior is often counter-productive to a safe learning environment.

Enthusiasm

Enthusiasm seems to be one of those nonverbal teaching skills which would be impossible to teach. However, Collins (1978) created an operational definition consisting of the following eight behaviors:

1. Varied vocal delivery;
2. Animated eyes, including raised eyebrows and consistent eye contact;
3. Frequent gesturing with the head, arms, and body;
4. Large body movements and change in position;
5. Demonstrative and vibrant facial expressions;
6. Descriptive and varied word selection;
7. Acceptance of ideas and feelings with vigor and animation;
8. High energy level, vitality, drive, and spirit.

Notice that of these eight characteristics only number one and number six are verbally communicated. The remainder are *demonstrated nonverbally*. Again, enthusiasm, like caring, warmth, and empathy, comes from inside the teacher. It comes from a love of the subject matter and a love of the students. Does being enthusiastic mean that we all have to get up on our desks to emphasize an important point? Certainly not. Each teacher has a different personality - thank goodness. Students have different learning styles just as teachers have different teaching styles. False enthusiasm is obvious to students and can distract from learning. One thing is clear from the research; student learning is directly related to the amount of time they spend engaged with the content. A teacher who loves her content and who loves her students will engage those students and motivate them to want to learn.

Modeling

When a person imitates a behavior or attitude, it is called modeling. Hopefully, the teacher is the model for many nonverbal student behaviors. By being polite and respectful to all of his students the teacher models the kinds of nonverbal and verbal behavior he would like from his students. When he touches "the nerd" or "the geek" on the shoulder just like he touches the most popular student, that nonverbal behavior demonstrates an acceptance of all people. Unfortunately, negative behavior is frequently modeled as well. Violence on television and at home is one model that is hard to overcome by a safe classroom - corporal punishment is still modeled in some schools.

Often our nonverbal behavior is incongruent with our verbal message. One study demonstrated the effect of incongruent communication (Bryan and Walbeck, 1970). These researchers showed that when a behavior was modeled and then the opposite behavior was verbally indicated, students imitated the nonverbal rather than the verbal behavior. If we send incongruent messages, our spoken words mean very little. What kinds of behaviors do teachers model which they want their students to copy? There are many of them. The teacher reads during reading time, writes in a journal when the students are expected to write in a journal, then shares the writing with her students. The teacher cleans up after herself at lunch; she shares her supplies in art class. The teacher laughs at her own mistakes and never at another person's mistakes. These are only a few examples; The reader can generate many more. Modeling is a very powerful nonverbal tool available to the teacher.

Expectations

Expectations can be considered a self-fulfilling prophecy for the classroom teacher. Every teacher, by now, is familiar with the controversial study and book entitled *Pygmalion in the Classroom* (Rosenthal and Jacobson, 1968). In their study the authors found that by manipulating teacher expectations students would perform at the expected levels. Students performed at high levels when teachers expected them to perform at high levels. The controversy came from a lack of replication in further studies. But recent studies have indicated that, in some cases, teacher expectations are powerful.

Brophy and Evertson (1970) found that if a teacher believes students can and will learn, then the students achieve at higher levels than those students whose teachers don't believe they can achieve. Teachers often expend less effort on perceived low achievers, ask fewer questions, do less prompting, give them less time to answer, give less praise than to high achievers, ask higher level questions of high achievers, ask lower level, factual questions to perceived low achievers.

In terms of nonverbal behavior, what kinds of things can a teacher do to indicate that she has high expectations for her students? Call on all students equally and be consist in nonverbal communication to all students. Use good prompting techniques for all students and give verbal an nonverbal praise such as "thumbs up" or the "O.K." hand signal or "high five" to all students. Make eye contact with all students and be aware that your body position is important. Face the student who is answering the question; never "dismiss them" in any way, especially nonverbally by turning your back or by not looking at them as they answer a question. Change the seating arrangement so that everyone "gets" to sit in the front seats or arrange your class in a circle. Try to address low achievers on a personal level every day. This demonstrates warmth, empathy, and high expectations. It models good behavior to the rest of the students, saying, in effect, "I care about all of you students and you should care about each other as well." And finally, try to live by the principles, attitudes and values that you want your students to live by (Kauchak and Eggen, 1989).

Often our body language has more impact on our students than what we say. Knowing that nonverbal communication can express so much meaning will allow us to start reflecting upon and analyzing our own behavior. It will allow us to explore new nonverbal behaviors. If we want to make a difference in our student's lives we must improve our ability to communicate nonverbally. It is recommended that the reader continue to explore ways which they can nonverbally, as well as verbally, create a safe environment and at the same time enhance their students' learning.

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Effective Engineering Presentations Through Teaching Visual Literacy Skills

by

H. Dan Kerns, Nial L. Johnson
Joseph T. Emanuel, and Kenneth A. Worthington

OVERVIEW

Since 1967, Bradley University's Department of Industrial Engineering has used the community as a problem solving laboratory for its students. Student teams are assigned to local organizations to help those organizations solve real operational and design problems. Although this effort has made students (and faculty) more aware of the types of problems that industries face and has improved the students' ability to become problem solvers, some obvious problems have continued to be areas of concern for the faculty. Two of those areas are the ability of students to clearly identify and analyze problems and the ability to clearly communicate the recommended solutions to these problems. Both of these problems have been tackled by a faculty team approach using faculty from Industrial Engineering, Communication and professional staff from Audio Visual Services.

The faculty resource team works with student project teams in an effort to improve their visualization and oral presentation skills. The student project teams are required to give several formal presentations both on campus and at the client's firm. Students utilize state-of-the-art technology to develop and display their visuals for the presentations. Color Macintosh computers and advanced presentation software packages are used in the creation of the visuals which are either imaged and used as projected traditional 35mm slides or are projected by a color data display panel. Incorporating this technology requires additional instruction time for students with the benefits outweighing the resources required. In addition to technology, students are taught visual thinking and visual literacy throughout the process.

The team approach to teaching students visual literacy skills has been successful. Evaluations of this approach have shown:

1. Students learn how to communicate more effectively through the use of visual,
2. A greater acceptance by clients of the proposed solutions presented, and
3. An increase in the implementation of the solutions by clients.

INTRODUCTION

Engineers are trained in applying engineering tools to solve technical problems. However, in today's competitive environment, successful communication of the solution is critical to the implementation of the solution and the success of the project. This paper presents a methodology for improving the visual communication aspect of presentations.

While this approach is currently being used at Bradley University in the Industrial Engineering senior capstone design course, this technique can be applied to many different environments. The fundamentals of this successful program can be used in teaching, team projects and other presentations. We hope to aid others who might want to adopt our method by providing a framework for how the process occurs. Our examples illustrate the tools students use in problem solving and organizing the material visually. The content of these examples (flow charts, cause-effect diagrams, etc.) is the process which we follow.

This paper is divided into various sections loosely based on the faculty team member's discipline. Many concepts crossover "traditional discipline boundaries" and become blended. No longer will you find the Communication faculty team member just talking about effective presentation skills. Additionally, one could find concepts of Visual Communication Theory being informally taught and demonstrated by Industrial Engineering faculty. The overlap and reinforcement of concepts has occurred over time. As the faculty team evolved through the process they have learned from the other disciplines. The end result of this cross-fertilization is optimizing ways to achieve the goal and objective of teaching students to become visual thinkers, visually literate and to improve their communication skills.

THE END RESULTS

In designing any course, educators ask themselves what knowledge should students receive from the course. One of the objectives of the capstone design course is to ensure demonstrated proficiency in Industrial Engineering skills. The second objective is to ensure that the students grow into visual thinkers and better communicators. To this end, we have developed a unique faculty resource team approach. The authors draw upon the talents of individuals from several disciplines to provide the type of education desired. Faculty from Industrial Engineering oversee the student's progress and provide leadership in the student's efforts in solving a real problem for a client in the Peoria area. Faculty from Communication work with the students in developing their oral communication skills and visualization techniques. Additionally, another faculty member works with the students to develop their presentation aids skills. Throughout the semester the students are challenged to think visually — from start to finish, not just at presentation time.

For example, a student team helped a local hospital implement a new accounting system. The old system required the input from many departments. Information that was contained on many different forms was used by a variety of departments. In solving this problem the students needed to understand how this information flowed from department to department and what information was needed by each department. The student team wrestled with this project — trying to define the real problem. They carried loads and loads of paperwork with them, but had trouble defining what information they needed and how they could incorporate it into only a few forms. After a suggestion by the faculty team, reminding them to think visually, the student team had a breakthrough. They developed a chart to determine what information was on each form. They quickly found that 80% of the forms in use by the hospital contained duplicate information that needed to be recopied onto each new form. The breakthrough was "seeing" what information was contained on the forms by visually presenting the information in a summary format. The team developed one form which replaced thirteen forms. This not only saved valuable time for the hospital, but the quality of information received was consistent and accurate.

DIAGNOSTIC TOOLS

The above example is just one of the diagnostic tools (matrix analysis) used by project teams in the engineering design process,also called the scientific method, in solving open-ended client problems. This process consists of seven major components:

- Formulation of the problem
- Analysis of the problem
- Search for alternatives
- Evaluation of alternatives
- Specification of the preferred solution
- Implementation of the solution
- Monitoring and controlling the system

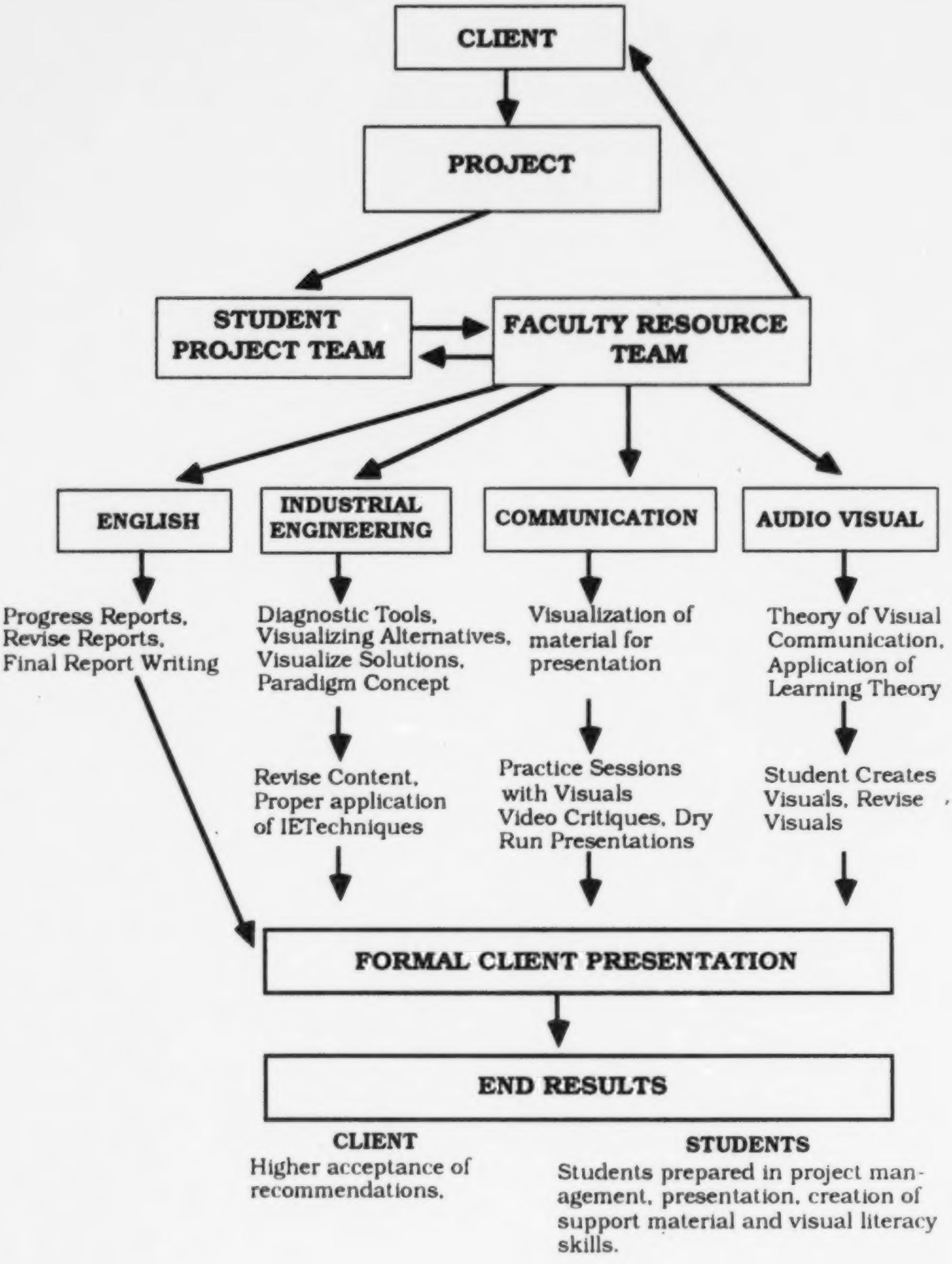
Throughout this process, students use a set of diagnostic tools which allows the students to analyze the problem. Much of the data available from the client is in numerical format. Using diagnostic tools gives students a more visual format for displaying and understanding data. The diagnostic tools are especially useful for tracking the problem symptoms back to the root causes. Without establishing the correct link between symptoms and causes, an appropriate solution to the problem cannot be found. A sample of diagnostic tools commonly used by the project teams includes:

- *Flowcharting* is the visual representation of people, materials, or information through a system. **See figure 1.** This technique helps students understand the current state of the client's problem. Flowcharting is also useful to show the difference between the current state and the proposed state.

- *Pareto analysis*, also called the "80/20 rule", rank orders the data according to relative contribution to a problem. The top contributors are identified as the "vital few" contributors. The rest of the contributors are called the "trivial many". Since limited resources (time, money, etc.) are available for solving the problem, concentrating on the vital few will allow the team to make recommendations which will affect a significant chunk of the problem. This technique can be displayed in table form or graphically to illustrate the vital few clearly.

- *Cause and Effect Diagrams*, also called "fishbone" diagrams, illustrate the relationship between symptoms and causes. As teams gather information in the problem analysis phase, they organize the information into a cause and effect diagram. **See figure 2.** The symptom(s) should appear on the right end

FIGURE #1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STUDENT PROJECT TEAM
FACULTY RESOURCE TEAM
ENGLISH
INDUSTRIAL ENGINEERING
COMMUNICATION
AUDIO VISUAL
Progress Reports, Revise Reports, Final Report Writing
Diagnostic Tools, Visualizing Alternatives, Visualize Solutions, Paradigm Concept
Visualization of material for presentation
Theory of Visual Communication, Application of Learning Theory
Revise Content, Proper application of IETechniques
Practice Sessions with Visuals Video Critiques, Dry Run Presentations
Student Creates Visuals, Revise Visuals
FORMAL CLIENT PRESENTATION
END RESULTS
CLIENT
Higher acceptance of recommendations.
STUDENTS
Students prepared in project management, presentation, creation of support material and visual literacy skills.

FIGURE #2

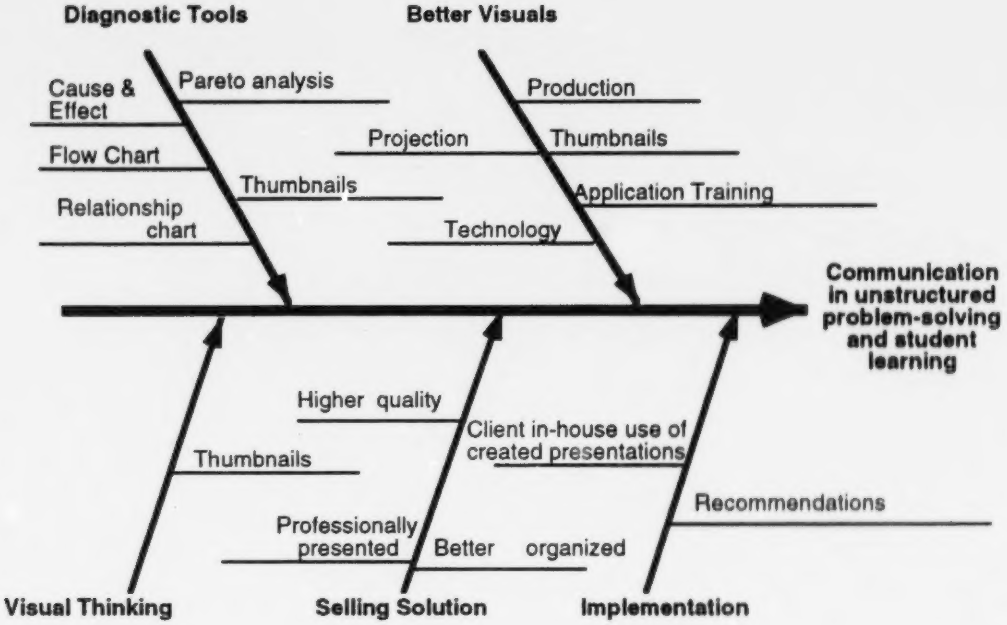
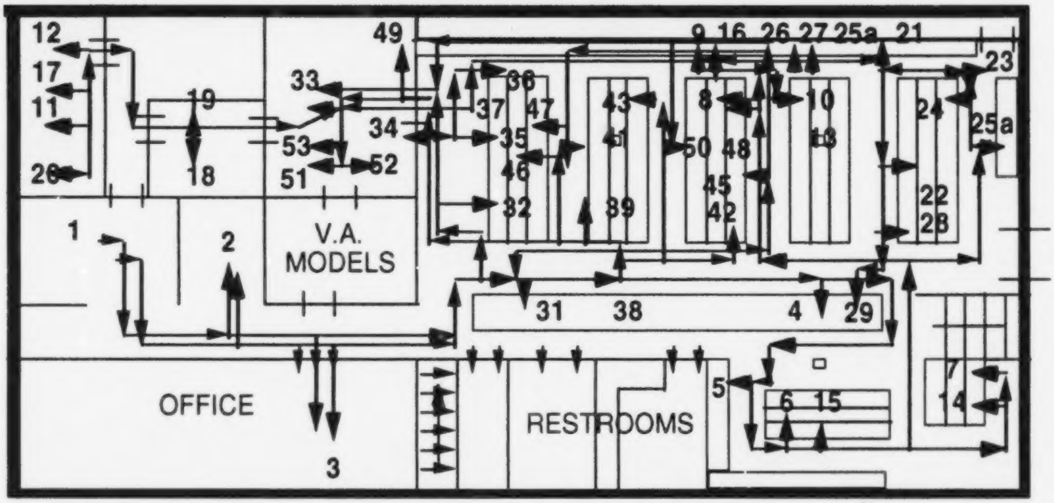

Diagnostic Tools
Better Visuals
Cause & Effect
Pareto analysis
Flow Chart
Thumbnails
Relationship chart
Production
Projection
Thumbnails
Application Training
Technology
Communication in unstructured problem-solving and student learning
Higher quality
Client in-house use of created presentations
Thumbnails
Recommendations
Professionally presented
Better organized
Visual Thinking
Selling Solution
Implementation

FIGURE #3

CURRENT LAYOUT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(head of the fish) with the suspected major contributing causes forming the main branches off of the spine. Brainstorming can be used initially to develop the skeleton. The sub-items under each main branch will be filled in as more information is collected. Brainstorming by the team will provide some theoretical causes. Then the team can investigate each theory and fill in the sub-items with facts or discard the main branch as the investigation continues. This tool allows the team to solidify their understanding of the problem within the group and to use the diagram as an aid in problem discussion with the client. Additionally, this single visual tool discourages students from solving individual problems in isolation and encourages them to take a systems approach to solving the problem.

- *Matrix analysis* is a combination of Pareto analysis and a relationship chart which is used to identify multiple causes of errors. This is the tool used in the hospital example.

All of these diagnostic tools allow the students to visualize the problem in order to establish the relationship between symptoms and causes. This analysis is critical to providing an appropriate solution for the client.

The following examples have been included to further illustrate the importance of diagnostic tools. A student project team worked with a local utility to develop a model to be used to establish guidelines for purchasing natural gas. Multiple suppliers, multiple storage fields and multiple transportation pipelines were available. Even the department charged with making these decisions had difficulty understanding the decision options that were available.

One of the student team members developed a schematic "picture" of the allocation process so the students could make sure they had defined all the parameters of the system. Upon showing their picture to the the president of the company, he remarked that this was the first time he had actually understood the problem the company was trying to solve. In tackling problems that involve the flow of material (or information), a layout of the facility drawn to scale, a series of arrows on the layout showing flow **(See figure 3)** and some type of pictorial representation showing the steps in the process helps groups involved in the problem solving process identify and understand the parameters of the problem and what steps might be taken to solve the problem. Until the student teams make a commitment to put this information on paper, they tend to talk "about" the problems rather than being able to identify exactly what the problems really are.

APPLICATION OF SKILLS

As with any educational endeavor, simply telling students how to do something isn't as effective as demonstrating and requiring student participation. The faculty team demonstrates visual thinking skills throughout the semester in the way they teach as well as requiring participation in skills taught. Students have the use of a color Macintosh lab with the needed software to create quality presentation slides. A faculty member from Communication teaches theories of visual communication and demonstrates those skills.

Student project teams are exposed to formalized demonstrations of visual material production and utilization twice during the semester. An administrative staff member serving a dual role as AV Services Coordinator and instructor in the Communication program provides group instruction in the use of Microsoft Powerpoint® utilizing a color LCD plate, wireless remote control, and the desired computing platform. Students are instructed on the theory of visual communication which covers basic information concerning legibility, type size, color, background material, and designing for the medium. In addition to application specific instruction, the value of producing high quality, aesthetic visuals which are very legible is reinforced. Students are expected to use this newly acquired skill as early as the first assignment in which they are asked to turn in one visual produced using this application. Remaining assignments for the duration of the semester provide the opportunity to refine visuals during regularly held report sessions. Students were provided with limited color palettes and backgrounds in order to reduce the amount of time spent "playing around with choices".

The second meeting (utilizing different presentation mediums) provided the project teams with a Q&A opportunity from the first meeting and ensuing assignments — Why doesn't this work? Can I do that? How do you achieve this? Discussions concerning the value of using visual aids in retention, the various visual aids available and their impact on group size. Additionally, strengths and weaknesses of each are discussed as well as cost, production constraints and review of production guidelines. Samples — not only what can be done, but more importantly, what students have produced over the past five years are demonstrated. Examples from both ends of the scale are used — what has been successful; what has come up short - why for each.

After the basics skills are covered, the project teams are also provided handouts from the office of Audio Visual Services which provides an introduction to the variety of support services available. As a comprehensive media service offering consultation, production and equipment support this further strengthened the base for student productions. Project teams are able to set independent meetings with the Coordinator (a member of the faculty resource team) to discuss ideas, concepts, and in general refine visual support materials. These meetings provided the opportunity to tailor presentation visuals and discuss information visualization.

Historically, the services provided by the Audio Visuals Services were those of an in-house production department. As the faculty team approach and technology progressed and evolved, services changed from that of a production service to support and instructional services. Early on, services required professional and supervised student staff from Audio Visual's photography, typesetting, and graphic design units to produce student visual support materials. Professional staff was needed due to the complexity and skill level required to make visuals. Although manageable at first, "spreading the word" to other departments created a landslide of senior projects at the end of each semester which created bottlenecks in all productions areas. Ongoing review and evaluation by the Faculty Resource Team led to the University's purchase of a color Mac and presentation software and a shift to student produced visuals with appropriate instruction.

Student produced presentations were stored on computer files and were processed by a "customized" service bureau developed by AV. Students bring the visuals they created on disc to AV to be imaged into traditional 35mm slides. Before the images were processed, the electronic files are critiqued for legibility, appropriateness, simplicity and effective design. AV professionals often consulted one another and used their experience to discuss ways in which to enhance the visual aspect of the presentation which might have eluded the student skill. Production bottlenecks were reduced due to the redirected production and turn time was enhanced for all. AV imaging however, was scheduled to achieve the maximum number of film rolls per day which provided very little margin for error, fixes, or additions. Dry runs or final rehearsals generally resulted in minor fixes or the creation of just one or two more visuals. This of course was usually a day or so before the final presentation to the the project client — CEO, president, VP, manager.

Today, this process has been further refined through the acquisition of technology. Where students still produce their own materials and AV images them, the dry run and rehearsal process has benefitted from LCD panels. LCDs have relaxed deadlines, enhanced the ability to make last minute error corrections, allowed student groups the opportunity to sort and easily restructure the flow of their visuals, and provided the service bureau flexibility in scheduling high resolution imaging. Although the project team believes that film-based visual aids are of higher quality and impact, student groups who have used LCDs as their final presentation medium have aroused the curiosity of client groups in this technology.

PRACTICING THE PRESENTATION SKILLS

The next area of demonstration is in the coaching sessions which are devoted to examining the material the project team wishes to present to the client. The project group is required to have a full sentence/full content outline prepared for this meeting. The outline is examined to judge what material can be deleted and what needs to be added in order that understanding and comprehension can take place on the part of the client. Once a completed outline is finished, the project team is encouraged to brainstorm to relate the material at hand to the audience visually. This is important and necessary when the material at hand is technical or complex. This session falls after the project teams' meeting with the Communication faculty who have discussed with them the basics of visuals. Many questions are raised by the communication faculty member:

- Can pictures inside the plant help illustrate the point that you're trying to make?
- How are you going to interact with your material?
- Does your client have a preferred corporate look to the visuals?

- How can you spruce up your visuals for a more effective professional look?
- What "hooks" can you provide in your visuals to reinvolve those who may have tuned out during a portion of your presentation?

This session generally proves to be very useful. Many rough, thumbnail sketched visuals are prepared. To aid in the design of the visuals, templates for slides are available so the project team can better understand the space constraints of the medium. Many of the dividends of this session pay off with the next visit to the client's firm. The project team begins to look for those things which could help them tell their presentation visually.

Over the next three to five weeks the communication faculty member holds a series of coaching sessions with the project teams. The majority of the sessions falling closer to the dry run and client presentation. An IE faculty member attends these sessions to help insure accuracy of the technical content. The sessions are videotaped and immediately reviewed and oral critiques follow. The group as a whole benefits from reviewing the videotape. They get to see first hand not only their own portion of the oral presentation but also that of their peers. This helps reinforce the positive aspects while also underlining the less than desired behavior. At this point the bulk of the research has been conducted, the written report is well underway and the presentation is taking shape. The remaining sessions are generally spent fine-tuning the delivery aspects of the speakers.

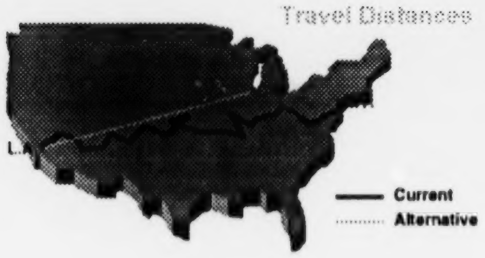
DRY RUN AND CLIENT PRESENTATION

As the semester draws to a close, all the aspects of the project come together. Students are required to make a formal presentation of their semester's work to an on-campus group. This dry run presentation is a dress rehearsal for the student's client presentation. All aspects of the presentation are in there final form, although some changes are identified as a result of audience feedback.

The client presentation is a formal presentation, usually held in the board room. The CEO, president, VP, manager and steering committee are generally in attendance. One of the points the Communication faculty member stresses early on is the per minute dollar value of personnel assembled for the final presentation. The top administrators for the organization are assembled. The students must be able to present the information in an organized fashion and have the client assimilate the information quickly and accurately.

Good effective visuals are a must. An example of this is one student project team who worked on a layout project for a dental appliances design and manufacturing firm. The current layout had material unnecessarily traveling throughout the firm and backtracking in several locales. To illustrate the extent of the problem, the group calculated the distance travelled by their employees — 3400 miles a year while carrying four cases and then used that information to design a visual representing that distance from LA to New York. This was very effective in captivating the attention of the client. **See figure 4.**

FIGURE #4



EVALUATION

One of the measurements of effectiveness is whether the students become visual learners. We have several evaluation procedures to gauge this.

One obvious method is gauging the success of their semester long project. The students complete a comprehensive written and oral evaluation. Factors evaluated include:

- themselves
- team members
- faculty input
- client input
- quality of problem
- quality of solution.

The faculty evaluates both the students and their own performance, which results in constant modifications and improvements in the process.

Another measure of performance is delayed feedback from the students. After graduation students often call, write or stop back to express their gratitude for the experience. They are often well ahead of their peers at the firms where they are employed. The former students offer thoughtful reflections on the process and offer suggestions for future project teams.

An additional measure of effectiveness of the process is greater implementation of recommendations by the client. This acceptance of the students' proposals couldn't have occurred unless the students were able to define the problem, present the information, offer recommendations in a clear and concise fashion and "sell" the solution. We firmly believe that the ability of the students to examine the problem pictorially and visually present alternatives and solutions results in the greater acceptance by the client. Often the client asks for a copy of the presentation visuals to use to present the information internally. Additionally, we have had clients ask for seminars on creating visuals and presentations.

EPILOG

In the end, we produce visually literate students, equipped with the necessary engineering and communication skills to be highly competitive in the work force. In a minimal sense, we have exposed the client to visual literacy skills.

Since 1967 the process has evolved greatly. The evolution is ongoing — the Engineering capstone design course is in a constant state of flux, changing with technology and approaches. Fifteen years ago, we looked at the student groups and thought we'd reached the peak — they were really good. The process has changed numerous times since then and will continue to change and so will we. Here are our predictions for the future of our project.

FUTURE

The faculty team's projections for the future of the Industrial Engineering capstone design course includes the following changes which correspond to advancing technology which will again find their way into this process.

Multimedia on the desktop will provide the opportunity to blend still and motion video, animation, and static images into powerful client presentations. Today's projection devices are already capable of providing for this mix. With this change however, it is perceived that students will once again become more dependent on production professionals for the bulk of their programs.

Enhanced hardware platforms that incoporate leading edge technology such as photo CDs and full motion video to provide digitized visual support and desktop videoconferencing to provide convenient means of communication will allow students additional resources for accessing and producing presentations.

Growth of computer networking and problem-solving software such as artificial intelligence and total quality management which will allow the problem solving process to be shared by more users which may change how information is shared for team problem solving processes.

Improved simulation software which will allow processes to be modeled more accurately and displayed more accurately. Viewing a simulation of the current process in a team setting will stimulate team members to generate more ideas for investigation and ultimately provide a higher quality solution at a lower cost.

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Preparing Teachers for Using Instructional Television in Diverse Cultural Settings

by
David G. Gueulette

Many recent and exciting developments in the production and delivery of instructional television have encouraged teacher education programs worldwide to incorporate video activities in their pre-service and in-service courses. Video in all its many forms but especially in videocassette format has emerged as a major means of delivery of instruction after the use of lecture and overhead transparencies. Given this explosion in the use of the medium, it is essential that it be employed correctly and effectively. It is especially important to use television appropriately in international and multicultural classrooms.

Very probably we will be using more and more video for multicultural instruction, thus we must demonstrate how to use it judiciously and correctly. Additionally, we must not forget to point out the strengths and weaknesses of the medium and the role that it plays in educating and shaping the values of all societies and cultures.

In the Spring of 1990, a team of researchers at Northern Illinois University began to compile findings from a study investigating the most critical audience factors impacting the design and delivery of instruction for international learners in higher education settings in the United States. Results of early findings provided a direction for additional inquiry that is still continuing on the problems and challenges that face both learners from other cultures and their U.S. instructors in university environments.

Findings are being incorporated in bulletins called "Culturefax" that will be distributed to higher education institutions and other interested parties. These bulletins note special cultural factors that may prompt instructors to become more sensitive and more effective in their multicultural classrooms. These bulletins highlight, for example, whether a certain nationality is generally more comfortable in group or team learning activities or in more individualized programs, or how these international learners respond to mediated instruction.

Other findings that have been useful in developing the highlights have been: the presentation style and dress of the instructor, mediated materials preferences, personal treatment of the learners, use of glossaries to supplement existing texts for learners with language handicaps, timing and pace of instruction, and a dozen other factors.

Culturefax bulletins capture the research and offer examples of the multicultural instructional practices that deal with such topics as:

1. Platform skills in the multicultural education setting
2. Selection of appropriate media (especially television)
3. Pacing and timing of instruction
4. Treatment of learners
5. Special cultural factors or religious, political, or social considerations
6. Instruction in English factors
7. Subject matter issues
8. Classroom environments.

Key theoretical constructs that generated the research were suggested by the work of Philip R. Harris and Robert T. Moran (1987) who posited several categories of cultural conditions that can impact learning by adult internationals in classrooms. These became the general areas of inquiry that the study attempted to address.

The conditions are as follows:

SENSE OF SELF AND SPACE

COMMUNICATION AND LANGUAGE

DRESS AND APPEARANCE

FOOD AND EATING

TIME

RELATIONSHIPS

VALUES AND NORMS

BELIEFS AND ATTITUDES

MENTAL PROCESS AND LEARNING

WORK HABITS

The cultural impact on learning could be further refined to cover these educational sub-heads:

TEACHER PERCEPTION

ENGLISH PROFICIENCY

CLASSROOM ATTITUDES OR BEHAVIOR

PERSONAL VALUES

OTHER

These categories and subheads were analyzed and formed into statements that could by tested for specific cultural groups. The initial intent was to clarify these statements to generate responses that could be developed into hypotheses. The final outcomes would not be facts, findings or generalizations but rather testable statements derived from the collection of answers.

This approach was also recommended in a dissertation by Dr. Jeanne Hites (1990). She suggested the development of testable statements for A.T. & T. instructors who were involved in the teaching of technical switching systems. She also employed a process termed: "triangulation" to confirm that the statements from international respondents were as valid as possible.

So, using "triangulation" that included student comments, previous instructors' comments and any written or anecdotal data available, Hites generated hypotheses that could be tested by in-service instructors at A.T.&T. This puts research on international teaching/learning at the appropriate and most relevant level: the classroom. It also provides the investigator with very reliable and valuable hypotheses that can be tested and possibly lead to improved classroom instruction and learning. It also attempts to avoid the so-called, "Margaret Mead" error of generalizing too extensively from respondents without other types of corroborating evidence.

This same "triangulation" method using students as respondents, instructors as informants and written or anecdotal information in support of each statement or hypothesis was utilized in the this study. As mentioned earlier, the statements have been put into bulletins entitled "Culturefax" which will be provided upon request to interested instructors, instructional designers and others.

Currently three cultural/national audiences have been examined and pilot "Culturefax" bulletins produced. These are: Philippines, Thailand and Indonesia. Upcoming bulletins will consider learners from Malaysia, People's Republic of China, Kenya, Taiwan, South Africa and Egypt. In addition to the printed bulletins a "LINKWAY", IBM interactive instructional program, is available for the Philippine's version of "Culturefax". Future interactive programs are being developed for several other countries as well.

One of the important findings of the Culturefax process has been that the use of television is an especially critical classroom activity. International respondents indicated that using the medium in the typical U.S. fashion presented some difficulties for students from other countries who saw television as a medium for entertainment only. They typically mentioned that using television was frivolous and lacked the credibility of lecture or other types of classroom exercises.

This information has lead to an investigation of the use of instructional television in the multicultural environment and the development of some guidelines for its use.

As a result of the vigorous applications of the medium for teaching throughout the United States and abroad, two important problems have become quite evident; 1) the overuse of inconsequential video programs and 2) the misuse of video programs. It is not difficult to appreciate why there is such a temptation to use television in its many forms. We have only to consider the array of sources of television programs and equipment now available to the teacher in the multicultural or international classroom.

It is probable that teachers are overusing taped or broadcast video and that they are often not using video in planned and effective ways to support instructional objectives. Reports from learners and teachers alike seem to support these concerns. This is unfortunate, especially given that there are several basic rules for the integration of television into instruction that are easy to understand and that apply and improve the use of the medium markedly.

1) Select good television programming that can be used to support your instructional objectives. Preview all the video you are considering and use only the parts that fit your objectives. Ask yourself the following questions about the video you consider:

a. Is it provocative?

b. Is it of good technical quality?

c. Does it have appropriate content?

d. Will it fit my objectives for the lesson?

e. Does it generate student activities or discussion?

f. Can I, as a teacher, use this video effectively?

2) Excerpt the parts that are most useful. The equipment features on VCR permit easy and effective use of limited sections of programs.

3) Plan how the video selected will be used in the actual lesson or class activity. Determine when and how you will use the video, whether the VCR and television sets will be available, or if you might have problems with using the equipment. Write the video activity into your lesson plan and lay out all activities you plan to do with the television segment of the unit. Remember that the video can be a particularly robust and interactive learning medium.

4) Prepare the audience for the television experience. Tell the viewer what to expect in the segment and provide questions or comments that will assist him of her in assessing the points in the video. Tell the audience what you expect them to get out of the activity. Tell the viewer what to watch or listen for, or what to remember or what to take down in notes. Tell the student what you will do after the viewing of the video.

5) Show the video. Make sure the program runs smoothly, but don't fidget with the equipment. Stop the tape, if you are using a recorder/player and ask questions, make comments or show certain points of special importance. Rewind to review important portions of the tape of fast forward through parts that are not useful to the lesson.

6) Follow-up the video experience. Give a summary of the video or remind the viewers of the planned expectations for the program. Use questions or comments to generate discussion or debate. Have a test on the program or require a written or oral report. Use the program's strengths to meet the objectives of the lesson. It is usually not appropriate to show a television learning activity without follow-up in a class. Perhaps, the only time when this may be advisable is when the program is complete in and of itself with well-defined points, reinforcement cues and built-in testing activities.

7) Evaluate the use of the video to determine whether you want to use it again. If you do choose to use the television activity again, do you need to modify it? For example, do you need to use more or less of the program, do you need to edit something out, or do you need to use better equipment? What better follow-up activities can you use next time? Review your use of the television activity overall to determine how you can use it better another time.

Two things that help a teacher continuously integrate television into lessons are: 1) a television materials evaluation check list or guide; and, 2) a list of useful video applications.

The basic rules are simple and effective. The teacher must play a positive role in the use of television for instruction in multicultural settings. He or she must use it judiciously and correctly-not only with some of the suggestions just mentioned, but also in ways that bring multicultural learners to a more "critical" understanding of the medium as it is used in educational classrooms.

As an example of a powerful and effective use of the medium teachers may want to consider using a "VIEWING GROUP" activity. A "VIEWING GROUP" activity might include the use of when selected video with the aid of 1. a theme or idea to be explored; or, 2. a critical examination of the producer's intent and the effect of the mediation. Group dialogue with the object of confronting and redefining reality could follow the critical viewing of the program. Participants in the group could begin to develop a critical view of the symbols, myths, and technical aspects of the medium and its impact on viewers and learning.

VIEWING GROUP GUIDELINES

1. SELECT RICH PROGRAMMING
2. USE A VARIETY OF SHOW TYPES
3. PROMOTE DISCUSSION AND REFLECTION
4. USE ROLE PLAYING OR VALUE CLARIFICATION ACTIVITIES
5. EXAMINE AND CRITIQUE THE EFFECTS OF THE MEDIUM AND THE INTENTIONS OF THE PRODUCERS
6. PROMOTE CRITICAL VIEWING

TO PROMOTE CRITICAL VIEWING:

A. DEVELOP ROBUST AND PROVOCATIVE THEMES OR IDEAS.

B. DISCUSS OR PLAN ACTION.....ENCOURAGE PRACTICE FROM CRITICISM.

C. CRITICALLY EXAMINE PROGRAMMING AND TOPICS.

D. MODEL CRITICAL ANALYSIS.

The approach is a good way to involve the learners in critical analysis of television and appropriate ways to use it both for delivery of instruction and as a subject of instruction. Teachers must play a positive role in the use of television for interactive learning in multicultural settings.

We must not forget to become and to help our diverse students become active, critical television viewers, viewers who are able to understand the strengths and weaknesses of the medium and the role that it plays in educating and shaping the values of our global society.

Additionally, we educators must assume leadership roles in the selection, development and application of culturally appropriate instructional television. We must make sure that mass communication systems, especially television, support a democratic philosophy of education. Finally, we have a responsibility to promote the potentially liberating possibilities of existing and emerging video technologies.

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The VISUAL ARTS

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The VISUAL ARTS

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For Whom the Bell Tolls and The Birth of the New Auteur Movement

by
H. Dan Kerns

"Do you want to be in pictures?" This is a typical question you might ask of an inspired individual, with starry eyes and big ambitions. But this is perhaps not the typical question to be posed to a multi-ton, massive yellow object. But in today's world of film that would indeed be an appropriate question you might ask of Caterpillar Tractor Company. You see, The Big Yellow Giant, as it is known, hired a product placement firm to find work in the movies and television for its yellow offspring. Caterpillar, like many other firms, has indeed found starring roles in movies through product placement firms and herein lies the problem.

Hugo Munsterberg said, "A good photoplay [film] must be isolated and complete in itself like a beautiful melody. It is not an advertisement for the newest fashions" (Munsterberg, 1979). Yet, unfortunately, that is exactly what the film industry is, an advertisement for the latest fashion and more. It failed miserably to isolate itself from advertising and, in fact, what the motion picture industry cranks out is feature length commercials.

What follows is a discussion of the state of the motion picture industry today, which is not pretty nor is it pleasant to think about, but we need to force ourselves to do just that! We, as individuals researching visual literacy, consumers and critics of the medium, need to demand change in the practice of product placement.

Why should those of us interested in visual literacy be greatly concerned about an entertainment medium when there are a great deal of other more pressing issues confronting us on the education front? Surely there are more appropriate topics that ought to occupy the minds of our researchers and academicians, right? Indeed, we are faced with other issues to consider, but the study of the placement of advertisements in film should be of paramount interest to our field. The product placers are applying the tools of our trade to advertise their products by using the visual medium to present and sell their products to innocent and naive entertainment seekers. They carefully analyze and read the text to find the best means to present their advertisement, which is often nonverbal. The power of this visual medium to influence buying behavior is tremendous. All one has to do is examine the success of Reese's Pieces after its appearance in *ET*. Film also conveys the implied product endorsement by the character and, to a lesser extent, the actor's themselves. Jennifer Beals in *Flashdance* drinks a Diet Pepsi after a rigorous workout. Thus, if she drinks Diet Pepsi in the movie, then she must really drink it in real life. People view films and television and are socialized by them. The populus is educated by film and television as well. For example, we know historically in film that good guys wear white hats and ride white horses. To imitate one's favorite hero used to require only wearing a white hat, riding a white horse—even if it were a broom, we play acted as if it were a majestic white stallion. Now however, viewers see time after time that heros drink Pepsi. To mimic one's hero today requires brand preference.

We need to critically analyze the impact of the message which is enveloped into character and plot development. The process by which humans come to understand the world around them is based on the stimuli that they perceive. If a large portion of this stimuli falls within the medium of film and later as programming on television, then we need to educate the consumers on the potential manipulation of our perceptions. We need to make viewers aware that Rocky only ate Wheaties because Wheaties paid big bucks for him to do so. Many are not visually literate, visually aware, and don't see these product placements as advertisements. To this end, we need to educate and inform the viewer. We can point to many tragedies and ills that come about due to an uninformed people. Finally, many of the consumers of the medium are children, the same group of individuals that are "protected" while viewing Saturday morning cartoons by the use of bumpers which separate the programming material from the commercial material. We do not have such luxury in films. The advertisements are intertwined with the plot and script and become inseparable. In some examples, such as *Mac and Me*, the product is the film, but this will be discussed in greater detail later. So yes, examining the visual (sometimes verbal) exposure products get in films is a very appropriate topic of study. This is an industry out of hand. What the film industry needs is self-regulation and, if necessary, imposed regulation by Congress and the Federal Communication Commission to prohibit product placements in future films. If prohibition is not the avenue taken, then films need to label all product placements at the time of placement in the film, as a paid advertisement. This is what is needed. And the time is now!

The bell indeed tolls for the creative juices which once raced through Hollywood. Gone from the film industry are the great directors such as Orson Welles, Alfred Hitchcock, Frank Capra, and John Ford. The high point in film has passed. What has replaced them is an unfortunate lot. Sure, American films were always expected to make a profit, but the method of making a profit today has caused the removal of the director from being the auteur (author or primary source of creativity) of the film. No longer is the director the person in charge of interpreting a screen play and "writing it" in his or her own style. Films no longer belong to the director at all. The film is the property of the "New Auteur": the product placer, the advertising huckster and corporate America with products to push. Films made today amount to no more than feature length commercials—shot for television, full of spectacle, wrapped around a plot which affords the most guest appearances for the stars—the almighty **PRODUCT!** This is sad but true—and many of the directors currently working in film have sold out to this practice. Yes, the bell does toll for each and every one of us who enjoyed a good film on a Saturday afternoon at the old Bijou.

The discussion in this paper will utilize an historical-critical approach to describe the use of product placements in films, a critical evaluation of where this trend has taken the industry, its effects on consumers and finally what action can be taken in the future. In an effort to organize events for the reader, the paper is broken down into stages of development. And finally, the approach to this paper assumes the basic premise that the auteur of a film is the person primarily responsible for the style and treatment of subject matter as well as the creative look of a film, thus the "author". In the past, the auteur has been the director. I propose this is no longer the case and that there is a new auteur.

The "New Auteur" movement can be broken down into the following stages: Acme Reality, "Ad"-ded Reality, and Anti-Reality! The last stage is a term which has roots in an article by Mark Miller, *Hollywood: the Ad*, 1990. I think it is a perfect descriptor for this stage—and many of the points Miller brings up in that article also bears mentioning later as well.

ACME REALITY

Early directors were careful to conceal the identity of an item, label it generically or with a made up name. ACME, Wham and Ajax are examples of products that were simply made up. The "generic" labeling of a product did not stand out and scream "I am PRODUCT X—Mr./Ms. Movie star used me, if you want to be more like them, all you need to do is buy me" like it does in today's film. If you don't believe me, ask any kid who saw *ET* what kind of candy the outer-space creature liked. In the "good old days," people didn't notice the product—that is, there was no brand identification. (Brand identification is something that product placers are currently selling to corporate America.) And as a result of the lack of brand identification, the audience's attention wasn't distracted from the plot.

This is not true today. Look at any number of films, *Back to the Future* (any in the series will do), *Rocky I* and any other commercial sequels that followed, *Mr. Mom, Flashdance, Field of Dreams, Mr. Destiny, Chances Are, Tootsie*... and the list continues. Certainly many can recall specific products from any of these films—actually, product placers would be more than happy to share the results of their research which indicates that audiences' "...recognition of specific products has ranged from as high as 96 percent...to as low as 12 percent" (Poe, 1984). And since we can recall a product, it is this very ability that is distracting from the true content film. In films of the acme-reality stage, one does not have that problem. Take the film *It's A Wonderful Life*, as a perfect example of an acme-reality film. Can you imagine, just for a minute, that the drug store in Bedford Falls that George Baily worked at was Super X and he fixed up the ol' Grandville house using Craftsmen tools (Bob Villa would be a special guest star)—let's not forget the real estate salesman who sold the house was in a yellow coat and the sign in the yard said Century 21—the bottle of champagne given to George and Mary by Bert the cop was Asti Spumante—the clothing George and Mary borrowed after falling into the pool were Calvin Klein—Zuzu's rose pedals were from the FTD Florist—(Merlin Olson would have delivered them) and Ernie's Taxi Cab would be, of course, Yellow Cab. Would the film have the long lasting staying power if the above were true? I seriously doubt it. I am, however, pretty positive that if Disney were to shoot *Bambi* today, Thumper would be the Energizer Rabbit.

“AD”-DED REALITY

The practice of placing products in films isn't a new concept at all. Actually there are some examples dating back to the 1940's. In *across the board,* Randall Poe writes “brand-name products have appeared sporadically in movies over the years, usually because a filmmaker was doing a special favor for a friend...”(Poe, 1984). Edward Epstein wrote in *The Rise and Fall of Diamonds*, that the advertising agency for De Beers Consolidated Mines, the diamond giant, was successful in convincing Paramount “...in changing the title [of a film] from ‘Diamonds are Dangerous’ to ‘Adventures in Diamonds’ “(Epstein, 1982). All in all, examples such as the above are exceptions rather than the rule. Early stages of product placement consisted of a firm giving free products for the duration of the filming in hopes that their products would end up in the final cutting of the movie. It wasn't until much later — around 1979 — that such “convenient placement” became a big business.

Robert Kovoloff and his placement firm Associated Film Promotions is “considered the founder of the business...”(Rosenthal, 1989, p. 44). He, like other placers, poured over scripts in an attempt to find areas that could be filled with products from the clients that he represented. He then would go to the producer and demonstrate what their firm could provide for the film. The studios were only too eager to take these freebies in an effort to keep their cost down, even if it meant shooting a scene with a real product rather than a made-up firm's product as we had previously seen in acme realism stage or a prop they had to purchase or rent.

These early entrepreneurs like Kovoloff saw an opportunity to make big bucks—and indeed, did so. Generally product placement firms work on a one-time yearly fee from a client. For that fee, depending on the product, they promise “X” many placements in films a year. The general number of films vary, but the magic number seems to be five. And, if the product gets left on the cutting room floor, as did the Independent Insurance Agents billboard in the movie *The Natural*, that's okay, there will always be the next film. “‘It was worth the effort,’ said Mr. Vinson [Senior Vice President of Communication for IIAA]” (Friedman, 1984). No big deal. Remember, this is the early days of product placement we're talking about. It all changes and rapidly so.

Just as the number of films a product appears in, the one-time fee varies with firms as well. Joseph Bohn wrote in *Automotive News* that the fee “could range anywhere from $50,000 to $200,000" (Bohn,1986a). Edmond Rosenthal stated the fee “has gone as high as $250,000” (Rosenthal, 1989). The higher fees are generally associated with the Anti-reality stage. There will be more discussion later on dollar amounts charged.

During the “Ad”-ded Reality stage, there was some concern for the appearance of propriety. “Another cautionary note: product placements should not be overtly commercial,” warns Robert Finehout in the Public Relations Journal (Finehout, 1985). Evidently, not many heeded this warning in 1985 since more and more product placements crept into the scripts, not just adding reality, as was argued earlier, but creating reality—advertiser's reality. With this, we usher in the Anti-reality stage.

ANTI-REALITY:

There are quite a few changes between the added reality stage and the anti-reality stage. Anti-reality stage saw an increase in the amount of control delivered into the hands of the product placers and to a lesser extent the firms the placers represented. Greed on the part of the studios aided and allowed this to occur. No longer were placement firms just looking over the scripts to see where their client's product might be used in a film, but placers would have scripts rewritten to include a verbal reference to a client's product or actual usage by an actor. Film producers were only too happy to accommodate the rewrite—for a larger fee. The studios also became major brokers in the placement of products in this stage as well.

As product placement became more of a "legitimate" business, with research to back up the sales pitch, the money charged to a client increased and so did the demand on the part of the client about the particulars of film placement. Anti-reality stage saw the rise to companies becoming more concerned with the appropriateness of the film their product and firm was to star in. The fit has to be right. MasterCard® was discouraged "...from participating in ...*Death Wish III*" (Spillman, 1985) by Rich Gore, its placer, "...it takes place in the ghetto and shows lots of people getting blown away. I don't think that would do MasterCard® any good'" (Ibid), Gore says. This is truly anti-reality, in that bad guys use MasterCards® as well as the good guys do (perhaps even more, not just their own cards either). The plastic gets plunked down on counters on Rodeo Drive and Fifth Avenue just as it does in Harlem. So the product placers concern for MasterCard's® "appropriateness" in a film no longer means that they were (as if they ever were really) concerned with boosting the reality of a film. Product placers are more concerned with image control of their products. We have the ultimate in anti-reality by the product placers not placing a product in a film because of the image. If they were wanting to really portray reality, then they would place the credit card in the film and show both legitimate and illicit uses of the card. This is how it appears in real world reality. So the lack of placement in this case is paramount to anti-reality.

Notice the concern of the "appropriateness" of MasterCard® in this film. This is indeed an example of a strong negative visual image and MasterCard® does not want the audience to wrongly learn from this negative visual.

Yet on the other hand, the placement of 7-Eleven stores in the movie *Cannonball Run* was anti-reality in that the only station that Burt Reynolds stopped at in his cross country adventure was 7-Eleven. The producer of *Cannonball Run*, Albert Ruddy explains, "'...If your film is crossing 3,000 miles of the U.S., you can't keep pulling into gas stations and convenience stores which have no names'" (Poe, 1984). This is really absurd reasoning. It is a classic case of anti-realism because of the exclusive placement of 7-Eleven. It is anti-realism to propose that someone is going to: a. always fill up at the same brand name gas station. b. always find the same brand name gas station when they need gas. The statement that Burt couldn't pull into gas stations and convenience stores which have no names is anti-realistic, in that there are quite a few of each without much more than "Dick's Gas and Food For Less" as the name. "Mom and Pop" still live and still own stores, restaurants, gas stations and their ilk.

Product placers are commanding and getting enormous amounts of control in the early stages of anti-reality. They are now exhibiting overt characteristics signaling the final stages of metamorphosis of the new auteurs. One product placer is quoted as saying, "'We choose the projects where we have maximum control....We break a film down and tell the producers exactly where we want to see our clients' brands'" (Miller,1990).

To further illustrate the power of the New Auteurs, consider that a "...scene in *Cocoon: The Return* was reshot so that Quaker Instant Oatmeal could be displayed more prominently" (Reed, 1989). This too, is an identifiable trait of the New Auteurs.

Remember the Independent Insurance Agents billboard getting left on the cutting room floor? The attitude during the "ad"-ded reality stage was "Oh well, there will always be the next film...". In the Anti-reality stage, this has changed. Strategies for placements now exist. For example, in the film *Die Hard 2,* there was scene where Bruce Willis was to use a cordless screwdriver. Through the product placement firm and the advertising manager at Black & Decker, a deal was cut to use a Black & Decker Univolt drill. There was even discussion of working the tag line of Black & Decker into the script. The product placement firm even provided evidence that this would be ideal for Black & Decker, "This hands-on usage in a heroic effort will make a memorable impact upon the film's audience. Research indicates that this type of film exposure results in brand recall two and a half times greater than that of television commercial advertising (a 56 percent average recall, compared with a 22 percent average for television)" (*Harper's Magazine*,1991). As it turned out (if you haven't guessed already), the scene which featured the drill was cut from the film. Instead of "Oh well, there will be other films," Black & Decker has "...filed a $150,000 lawsuit against [Twentieth Century] Fox..."(*Harper's Magazine*, 1991). Firms are no longer content with the notion that another film will come along.

The practice of placers "assisting in reality" by supplying products for films, while collecting huge profits for themselves continued for the formative years (the "ad"-ded reality stage) of the business. But soon, however, it dawned on many of the studios, probably much like the awakening by the first proprietor of the "world's oldest profession", why give away a very desirous product that someone else is willing to pay good money for. It seemed kind of silly, in retrospect, that someone else would be selling the studios product for a huge profit, and studios were getting a very small return for their participation, so why not cut out the middleman or at the very least cut themselves in for a piece of the money pie. And that's where we are today. *Time* reported "'Walt Disney Co. [is] soliciting paid product placements in a new film, *Mr. Destiny* '" (*Time*, 1990). They are selling off parts in the script to firms willing to pay— "'...$20,000 for a visual, $40,000 for a brand name mention with a visual and $60,000 for an actor to use the product'" (Ibid.).

If this sounds as if filmmakers are tailoring a script for a certain firm's products, it should. The script was changed in *Rosemary's Baby* to include a reference to Lipton's Tea (Finehout,1985). One could pick any number of scenes in *Murphey's Romance,* a Coca-Cola/ Columbia Pictures production starring Sally Field and James Garner to prove this point. "Sally even asks James at one point in the movie, "'Could I have two Extra-Strength

Tylenol and a glass of water please '"(Miller, 1990, p. 44)?

Not only are scripts being written and rewritten for products depending on what the parent firm decides to pay, but in some films, complete television commercials are being worked into the films as well. In the movie *Power*, Richard Gere watches an Aim toothpaste commercial on television (Spillman,1985). *Johnny Be Good* features a commercial for shoe-giant Adidas (Sheinfeld, 1989). Peter Sellers watches a commercial for Natural Light in his film *Being There*. And the coup of commercial placements goes to *Lethal Weapon 2* which features a commercial for Ramses condoms. Not only does Ramses get a commercial in the film, but they also get a running joke throughout the movie (*Newsweek*, 1989).

If you have a product, the new auteurs can fashion a movie out of it, even it requires stealing a plot, as a vehicle for your product. Enter *Mac and Me*. *Mac and Me*, is a feature length commercial made entirely as a vehicle for Coca-Cola, McDonalds, and Sears. The producer, R.J. Louis denies that his intention was "'...to focus on a product'" (Skenazy, 1988). He's probably telling the truth, right? It's only a coincidence that there is a connection between these firms right? So McDonalds has a line of clothing that is sold through Sears—McKids, and Coca-Cola is the drink served at McDonalds. Just coincidence. And in the *ET* rip-off film, the MAC (Any chance of this being a coincidence, that MAC could stand for a restaurant chain or a certain hamburger?) is an alien who survives by drinking Coke. The listing of coincidences between the three firms and their intertwining in the plot(?) could go on to an ad nauseam degree, so I'll quit. P.S., Guess who also stars in this film? You guessed it, Ronald McDonald. The plot was stolen from ET, a wildly successful film during the "ad"-ded reality stage which launched the product placement business into its current greedy orbit. *ET* made Reese's Pieces a household word and caused sales to skyrocket "...150% in two months...[which] pushed Hershey Chocolate's sales to an estimated $1.2 billion, vs. 1981's $1 billion, and its operating income to $185 million, vs. 142.7 million" (S&MM,1983). Not bad returns for appearing in a movie, no wonder Mac and Me attempted to duplicate that for its sponsors.

Probably the most impacting of product placements has to deal with changing the image of the main character in the preeminent series of the spy genre films. James Bond dumped his trademark Austin Martin automobile for a Lincoln Continental Mark VII (Reed, 1989). But that's not the best of the James Bond world of placement. Guess what kind of cigarette Bond smokes? Larks. And for that, parent company, Phillip Morris paid a cool $350,000 (Miller, 1990). In the "ad"-ded reality stage, a mere $50,000 was sufficient in getting one's product into as many as five films—sometimes more. Well, $350,000 is a far cry from those days. But more important than the amount of money—don't get me wrong, this is very important, but a more pressing concern is the control over not only the script but the identity of a character. James Bond! The name in itself depicts a certain connotation, a certain imagery. James Bond is the exalted deity of the spy genre, which glorifies among other things, the conspicuous consumption of expensive items and gadgets. These items are not the things that ordinary citizens might have, but something special, something awe inspiring, something worthy of such greatness. By the simple fact that Bond no longer drives an Austin-Martin or smokes perhaps Italian cigarettes, the product placers are impacting a genre. A good argument might be mounted that the new James Bond films are no longer a part of the spy genre because one of this most basic and important elements have been removed—James Bond as a romantic hero, being superior to everyone else and having more power as well is gone. Yes, James Bond is one of us. He is no better than the overweight Detective Frank Cannon, of the television series *Cannon*, as he too, drove a Lincoln. No other conclusion can be made.

The new auteurs have also changed the film style. This is evident in the anti-reality stage. No longer are films shot for the big silver screen, but for television. Gone are the rich deep focus shots of Welles and the panoramic view of a John Ford western. Left in its place is the close-up with the foreground emphasized. For proof of this one needs to look only as far as *Rocky III* when Stallone tries to convince his son that "Wheaties is the Breakfast of Champions." Or as Vincent Canby stated in the *New York Times* about the movie *Little Treasure*, "'The containers of Coke don't actually receive more closeups than Miss Kidder, but their closeups seem more lingering and loving'" (Spillman,1985). No longer do we need to letter box films so we won't miss anything, the technique employed by the New Auteurs insures that everything falls within the essential area, displayed prominently.

The main reason for this shift of technique is the impact the new auteurs (the product placers) have over the film. They realized early in the "ad"-ded reality stage that the film has a much longer afterlife on television than the life span during the theatrical release. Soon it would show up on pay per view, subscription television, video cassettes, foreign release and eventually on broadcast television. The larger audience for any given film is after the theatrical release, Sheinfeld reported "...30 to 40 million viewers for a film's first release and with over 200 million thereafter" (Sheinfeld, 1989). and the new auteurs are filming with those numbers in mind. In the early days of television, with its insatiable appetite for programming, it looked to feature films as a potential supplier of material. Now, however, the film industry looks to television as the primary outlet for its product. Again, this is evident through the applied use of the new film technique.

Given the above fact that television is the primary outlet source of theatrical film releases, the Federal Communications Commission now has jurisdiction over product placement. The Communication Act of 1934, Section 317 requires an announcement "...for which any money, service or other valuable consideration is directly or indirectly paid..."(*Documents Of American Broadcasting*, 1978). But there is a waiver for theatrical films, because it was felt that theatrical films were "...produced principally for theaters..."(*Broadcasting*,1989). This no longer holds true today. Theatrical films are primary made for television, which brings up even more issues, such as James Bond smoking Lark cigarettes. Phillip Morris paid for that placement which is tantamount to a commercial. Congress banned "...all cigarette commercials on radio and television effective January 2, 1971... "(*Documents of American Broadcasting*, 1978). We now have a legality question over the airing of films which contain any product placements of cigarettes by cigarette manufacturers. The Center for Science in the Public Interest has petitioned the Federal Communications Commission to rescind the portion of its 1960 product identification and sponsorship statue (Section 317 of the Communications Act) to "...require a conspicuous disclosure every time a paid product placement is depicted" (*Broadcasting*,1989). "'Today's product placements, intended to persuade unsuspecting audiences, violate the principle that the public has the right to know who is trying to persuade it'"(*Broadcasting*, 1989). Marshall McLuhan seems to support this view when he sees, "...the film medium as monster ad for consumer goods. In America this major aspect of film is merely subliminal" (McLuhan, 1964).

The Anti-reality stage seems to be plugging along, digging itself deeper and deeper into the mire of an increasing anti-realistic world, while the New Auteur's continue their rhetoric of "increased reality through product placement" in an effort to keep the audience hoodwinked into what is really happening to the artform called film.

Where are we to turn? The film industry has yet to regulate itself—or see a need to. With the current mind set such as film director John Badham (*Short Circuit*) has, we can expect little change. He stated, "'If we can help each other, and it doesn't intrude on the movie, it's fine'" (Reed,1989). We can't expect the change to come from the New Auteurs--the studios or from the product placers, after all, it is their movement. It is uncertain at this writing what the FCC plans to do, if anything. Congress too, has yet to act on the idea of product placement in movies. Yet, one would think that there would be a public outcry. And if not by the public, where are the critics? Where are the formalists? Rudolf Arnheim and company, are you watching what is occurring? We need help! The bell is tolling for the death of an artform! Shall it die an undignified death? Won't anyone stand up and say something in its defense? Or are we all to wait, until it is too late, to speak our peace, in the form of a eulogy? Perhaps the New Auteur Movement, with its view of "reality" will pass, much like the movements which preceded it—leaving its mark on time as a reflection of an era past—just as the drawings of a caveman and the hieroglyphics of ancient Egyptians. Perhaps it will pass...or become the hieroglyphics of today!

Many points and questions have been raised in this paper, questions that do not have answers. But be sure of one point, we need to educate the audience. We need to teach critical viewing skills. Many researchers have talked about teaching critical viewing skills, but have often overlooked this aspect of film and television. The importance of deconstructionalism in the approach of critically analyzing the medium's message is vitally important. Those of us studying and teaching visual literacy need to discuss this area in your research and lesson plans. Certainly we are faced with a death of an artform, but we are also faced with the duping of a public.

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Art and Environment: An Integrated Study on the Web of Life

by
Karen Larson

Since we are thinkers as well as shapers of the environment, it is important that we become aware of our caretaker position too. A holistic world view emphasizes that the parts are only understandable if viewed in a dynamic relationship among all parts. Through holistic thinking and teaching, we can view ourselves, humanity, as only one of many elements within the Earth's complex and mysterious system.

Science and art have the ability to become great working partners through environmental studies. Curriculums that point to creativity as a resource for scientific problem-solving have not been promoted in most schools. Some educators stress this partnership through general appreciation of scientific rules that apply to art, but that is the minimal approach.

Art education combined with the sciences can be a leading force in raising the consciousness of students and teachers to the needs of our fragile planet. Although science education has led the way with such programs as *Project Wild* (Fleming and Knape, 1983), the arts can become a partner with science in a new and more holistic way in teaching.

By including environmental aspects to the visual arts curriculum, we will also be teaching that one of the similarities we all share is the need for beauty. The Earth's beauty is a powerful and mysteriously soothing force. As the mathematician Alfred North Whitehead once stated, "After you understand all about the sun, and the stars, and the rotation of the earth, you may still miss the radiance of the sunset." (Grieg, Pike, Selby, 1987).

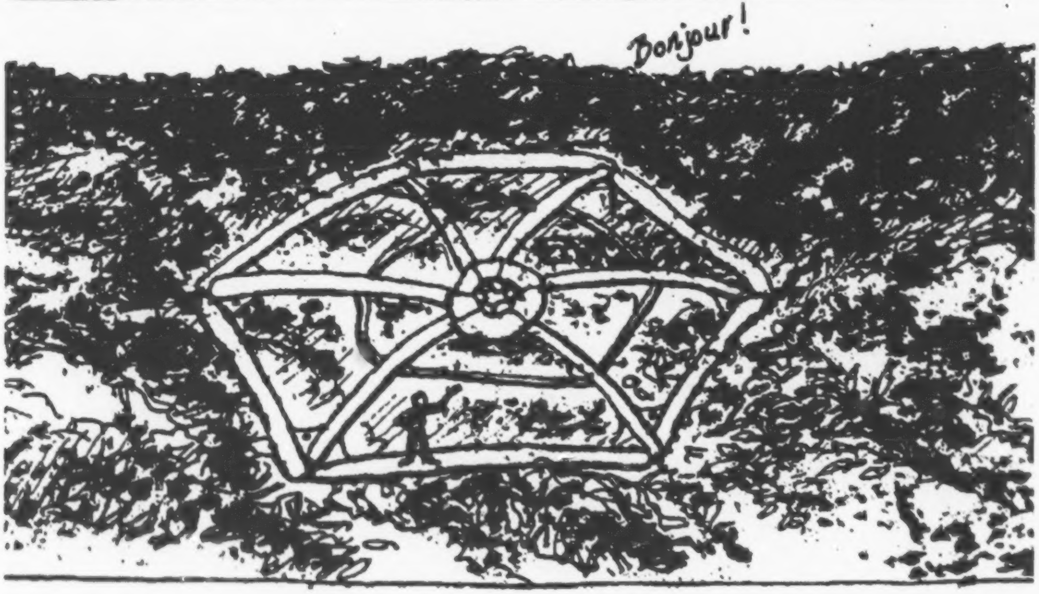
Dostoyevsky stated that beauty would save the world and it could be true. Beauty could save it because we respond to beauty and the lack of it. When the astronaut Charles M. Duke on Apollo 16 saw the Earth from space, he said, "The Earth is the most beautiful sight in space, with all its colors of land, sea and clouds . . . looking at it against the blackness of space was almost a religious experience for me." (National Geographic, 1972). Through an environmental curriculum and the use of creativity in a partnership with scientific thought, perhaps we can help find much-needed solutions to problems that face us and our environment.

The sciences traditionally carried the burden of teaching about the environmental and ecological problems that are in need of solutions. Art and science seem to be oceans apart at times in how the study of the environment is taught. Science has searched for technical and theoretical answers, and the arts have focused on the aesthetic elements of the Earth. What seems to have gone unrecognized is that to come to answers through science, there first has to be creative brainstorming and, more often than not, even some drawing.

When Archimedes shouted "Eureka!" upon discovering the displacement of volume in water by another weight, he was expressing his triumph through the use of creative problem-solving. Creative discovery lies in finding the universal in the particular.

Creativity in solving problems involves preparation, or the working on the question or puzzle; incubation, or time to think or play with the ideas; then illumination, or the "aha!" that Archimedes felt at his discovery. These three steps in a creative problem-solving process make possible the refinement of an idea that can lead to a solution that is wonderful for the problem solver.

A recent example of creative problem-solving that combines art and science is the visionary design of a "tree-top raft" created by the French architect, Gilles Ebersolt. The "raft" allowed scientists to study the French Guiana rainforest canopy that had previously been unexplorable. The canopy of the rainforest is fragile and too high for typical ladder supports. The geometrically designed raft balances on top of the trees, thus allowing scientists access to "walk" across the canopy to study plants, insects and animals that live there. The raft was a design that acknowledged the use of creative problem-solving in combining the arts and sciences to overcome a significant barrier to



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environmental study (Halle, 1990). How long would the botanists, zoologists and entomologists have taken to make the findings they did without the help of this brilliant artist who was concerned enough with the environment of the rainforests to create the treetop raft?

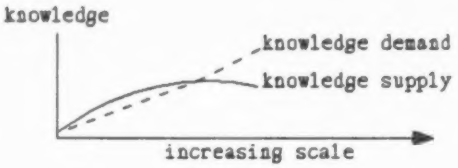
Heta Kauppinen (1990) said that we inevitably build onto the natural world to make it habitable for humans. Everywhere on Earth we have altered the natural environment. We have made these changes in a harmful and unthinking manner more often than with an understanding of what the implications of these alterations would mean to the earth. Kauppinen also stated that with an emphasis on environmental aesthetics we would design these alterations to be harmonious with the natural world.

Aesthetics alone is not enough, though. Students studying art can benefit by the contributions artists have made to the environment and by studying the use of creative problem-solving to come up with some viable answers to environmental problems. If the environment has suffered, it is not simply because of the failure of science and technology, but also due to a failure to include aesthetics in teaching about the environmental and its connectedness with humanity (Aesthetics and Environmental Education, 1985).

Holistic thinking is the single most important component to environmental education. A raised consciousness about the environment allows growth to come about through aesthetics and creative problem-solving. This approach will allow students to come to the realization that there is a unity to all life, symbolized by the web, and that they are a real part of the unity. To paraphrase Chief Seattle, if we touch one part of the web, it affects all other parts of the web as well (Vittachi, 1989). Understanding the web of life requires holistic thinking and teaching methods.

Presently the demand for environmental knowledge outstrips our knowledge supply. The learning curve below shows the desire we have to know more, but that new information is not readily available. "Many people who need information do not know that it exists or where to find it." (Margulis and Sagan, 1986).

Environmental Knowledge Supply and Demand
Margulis and Sagan, 1986, p. 97



Teachers are aware that, in facing the changes of the twenty-first century, they and their students are unprepared. Time is needed to allow teachers to prepare lessons that are relevant to the changing world. Developing creative problem-solvers and promoting self-expression through the visual arts are important to our survival in the next century. "The decade of the 90's, less than 4,000 days, is the last window of opportunity." says the director of the United Nations Environmental Program, Dr. Noel Brown (Jones, 1990).

Art and science can be on the same path when the goals revolve around exploring environmental themes. With a partnership and appreciation of each other's gifts, the discipline can make the issues become clearer and the outcomes can build from a stronger base. Students will have a richer variety of information for self-expression and also may find possible solutions to our alarming environmental problems through such an integrated art and science curriculum.

The curriculum can be divided into three areas of study: goals, problems, and approaches. The goals should include:

1. Enriched outlook on the partnership between art and science.
2. Possible solutions to environmental problems through utilization of creativity and science.
3. Confidence in self-expression from a solid base of scientific and creative abilities.
4. Enlightening others through the visual product.

The problems can be grouped as: Land, Water, Air and Population.

The approaches include:

A. Looking at the problem
B. Creative Drama/Imagining
C. Brainstorming/Thinking time
D. Creating

Our environmental problems are real. Our planet needs therapy from all of us. At Earth Conference One (1989) held at Oxford University there was a joke told about someone falling off the Empire State Building who passes a window waving to those inside and saying: "I'm doing great so far!" (p. 57). The sense of loss about environmental problems is like falling. It seems irreversible. Whatever differences we have about teaching and what to teach in art as well as science, we must come to the realization that we are all part of the whole. Pride can come in knowing that we do our best in trying to incorporate the sense of oneness into the lessons as we become a part of Earth's therapy and healing.

Lesson Plan Idea: #1

CONNECTIONS: CREATIVE THINKER - THE SPIDER

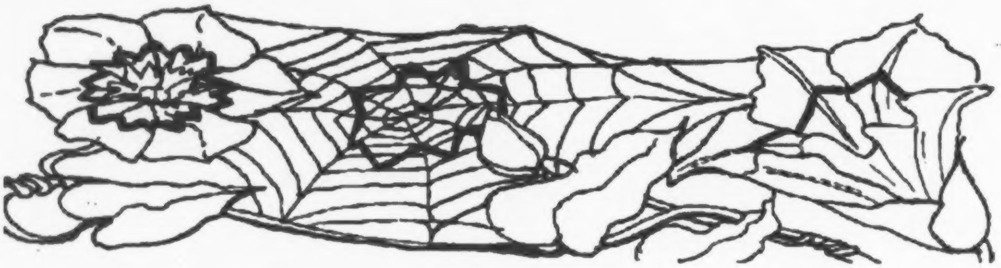
Students will learn about how some spiders have found a way to create ultraviolet (UV) light patterns in their web designs that resemble the UV patterns on many flowers. These patterns may be zigzags, crosses or bars. These designs mimic the same designs found on flowers that do have designs made with UV - reflective and nonreflective centers and petal designs. The UV light which only the sun and sky produce naturally is copied by spiders so that they attract nectar-loving insects that would see these patterns as another flower or a way out to open sky.

This lesson can lead to creative designs that are done with fluorescent pastels which will be visible under a blacklight in a similar way that UV light is seen by the nectar-loving insects. Students see how there are connections between species in nature that are subtle and yet help in the survival of a species. The concept of connections will be a good step in holistic thinking for the students.

Further study can then be done in a discussion on ozone depletion and the increased ultraviolet radiation levels resulting from this depletion. Students can do brainstorming and webbing to come up with parts of the problem: What are the main causes of ozone depletion? What steps are being done to stop it? What further steps can be taken to aid the situation?

Students can work on designs for ozone protection in the forms related to clothing and architecture as two examples. Cleaner transportation is another idea. Starting "small" by beginning the study with UV connections between spiders and insects and flowers helps with holistic thinking. This in turn helps expand the thinking so that students can begin to use creative thinking abilities in coming up with inventive ideas about ozone and ultraviolet radiation problems.

Idea from "Spider Trompe l'oeuil" in *Science* (1990)



Lesson Plan Idea: #2

CREATING A SOLAR HEATED DOGHOUSE

Students will use creative drama exercises to imagine being a dog, walking and resting in a dog house, picturing their environment and weather. From these imagining exercises they can expand their thoughts to see a more real image of the environment, the needs of the dog and how the house should look and function. The teacher can give the class basic information on what solar energy is and what materials would be used for this project.

Students can then create drawings and finally three-dimensional designs for the dog house.

Evaluation can come in the form of

discussion among the students who get to see all the designs they came up with.

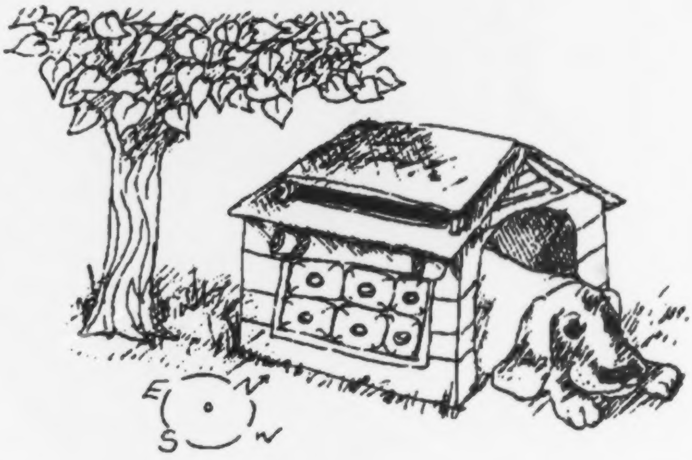
As an extra activity they could work as a group in creating a life-size model from one design they all agree is workable.

Another activity could be designing solar shelters for zoo animals. Since zoos are in many different geographical locations, they each may have specific needs for exotic species.

The Solar Doghouse

On warm days:

- vent the plexiglass roof window
- turn wall shutters to the white side
- put shade down over water-filled jugs used for solar heat
- tree leaves shade the house
- oriented to use the sun best at different seasons



Lesson Plan Idea: #3

RAINFOREST SIMULATION

Students are divided into groups of five or six. Each group is given an identity:

1. Forestwatch Environmental Society
2. Burgers-for-you Company
3. Government Resettlement Program Team
4. Kokopano Tribe
5. Infor Timber Company
6. Mediplants, Inc.

The teacher/facilitator leads the group through the simulation. Simulation can begin with creative drama: imagining walking through a rainforest, with all the details that can help in stimulating creative thinking. Students can discuss as a group what each of them saw, heard and felt. They will probably be surprised at the variety of images and thoughts from each other.

The room will be set up with a "rainforest" which is in the center of the room, made of 75 paper cups. During the simulation exercises, every five minutes each group which has a timber quota will gather their number of "trees" or hold mini-conferences with other groups to discuss cut-backs.

Each group will be given cards with

information relevant to their group. From these facts, they will have fifteen minutes to discuss their needs and ways to help save the rainforest. They will each send one member of the group to speak to the International Conference on Saving the Rainforest. The teacher will be the representative from this group and will listen to each speaker.

Afterwards the teacher can lead the groups in a discussion about this lesson:

> What did those working in the forest think about the ones who lived there?
>
> How did the Kokopano people feel about "outsiders" in the forest?
>
> What was the attitude of each group towards conservation?
>
> What would have happened to the rainforest if we continued for another 1/2 hour?
>
> Who should protect the rainforest?
>
> What steps should be taken to prevent the destruction?
>
> What might be the long-term consequences of this destructions for the forest people? For the world?

This type of simulation and creative drama helps students to see the many complex parts that are interconnected within an issue. Holistic thinking is better understood. Other lessons can be developed from this one: a series of posters with a theme of saving rainforests; a comic book on plants from rainforests that save lives; or a series of paintings that deal with one aspect of the forest and its life. Idea from *Global Teacher/Global Learner* (1990).

EXAMPLES OF ART THAT MAKE A DIFFERENCE

POSTERS: for organizations, advertising for companies, art shows, artists

STORY BOARDS: for videos - live or animated, advertising, short films, self expression, or documentaries.

CARTOONS/COMIC BOOKS: comic, ironic, serious messages

BUMPER STICKERS, BUTTONS, T-SHIRTS, STICKERS: all for a cause that has a strong view

INVENTIONS: all for a good cause

Small groups of students can choose an issue: water pollution, for example. They then can be given a choice of art to make a difference and decide on who does what part of the job. Some students may be best at lettering, some as landscapers or figure artists. Students can choose to work in small groups or as an individual artist on some assignments.

Drama Creation:

Students can become objects in small groups, such as an air pollution control device, or a water purifying machine. Or students can take imaginary trips to many lands or places of concern to the environment. They can float above a site or become part of it by becoming a speck of dust or microbe. Creative drama allows them to explore by using the imagination.

Brain Exercise:

Students can use ideas such as those in *Mindglow* to help them expand their thinking capabilities. Webbing ideas from a central idea out to many sub-ideas is one way. Putting unrelated elements together is another. For example:

What is the color of drought?
What is the sound of pollution?
What is the smell of acid rain?

Evaluating:

For students and teachers to discuss:

Did you give people information they could understand? Has anyone's outlook or attitude changed because of the work? Is the issue more understandable to you now?

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Cognitive Factors in the Study of Visual Images: Moving Image Recognition Standards

by
Nikos Metallinos

Knowledge of both the neurophysiology of the brain which underlines the functions of its information centers and the psychology of the mind which indicates its mental operations are important foundations for the study of visual learning. But they are not enough. To complete the study pertaining to the factors involved in the recognition and appreciation of television images we need to examine the cultural factors as they relate to the individual viewer, to society and the media institutions to which an individual is exposed, and to the idiosyncratic nature of the television medium. After all, individual viewers control both their biological and psychological activities and make the final cognitive decision as to the meaning they wish to assign to the pictures they watch.

However, viewers of the visual communication medium of television do not exist in a vacuum. They belong to a cultural environment which provides them with skills, habits, norms, learning, etc., all of which shape their behavior attitudes and form their experiences and memory systems. The standards for the recognition and final appraisal of television images can only be drawn accurately if the cultural factors that relate to individual viewers with society and the media are properly examined. This is precisely the purpose of this paper.

Specifically, in this paper the following topics are discussed: (1) the individual television viewer's general awareness, knowledge, expertise, values, beliefs, motivations, etc., (2) the individual's understanding of society, institutions, media, etc., and (3) the individual's knowledge and understanding of the process and the effects, the idiosyncratic nature of the visual communication media in general, and television, in particular.

A. Self-Awareness, Knowledge and Expertise, and Values

Although all cognitive operations of the human mind including thinking, understanding, interpreting, recognizing, etc. are, of course, subjective and idiosyncratic to the individual, we can predict how the individual will perform such mental operations when given a general task such as interpreting the message of a common television program. We assume that the individual viewer has the necessary knowledge, expertize, skills, and literacy to recognize, interpret, and appreciate the visual images to which he/she is exposed. From the day we are born to the day we die our parents, teachers, friends, institutions, and the society we live in all help to provide the guidelines which will help us survive, communicate with each other, and progress. The language, symbols, signs, and arts we learn and to which we are exposed are the common carriers for communication among us. They are the link that ties us together and makes us homogeneous members of the society.

Today's media technologies have reached worldwide dimensions and have transformed the citizens of the particular countries of the world into peasants of the global village (McLuhan & Powers, 1989). Culturally, politically, and socially inhabitants of the global village are influenced by media, particularly television, who are the hegemonies of the global village. Pioneering studies on the process and the effects of mass communication (Jacobs, 1961; McQuail, 1969; Schramm & Roberts, 1971), cultural studies on the influence of the media on artists expressions of the people in mass society (Rissoner & Birch, 1977; Rosenberg & White, 1957), social studies of the influence of the media on the individual's way of living (Agee, Ault, & Emery, 1988) and behaving in the society, and finally, critical studies on the artistic merits of programs produced by the media (Burns & Thompson, 1989; Newcomb, 1982) indicate that visual communication media, particularly television, decisively influence the individual viewer.

Under those circumstances how, then, does an individual obtain the necessary knowledge and expertize to accurately recognize, clearly understand, and properly interpret the moving images of the television programs he/she is watching? What should the viewer's standards be for the accurate execution of these cognitive processes? It is suggested that self-awareness and knowledge, expertize and confidence, values, beliefs, and motivation be among the most significant standards.

1. *Viewer's Self Awareness and Knowledge.*

Although it is increasingly more difficult for the average person to escape the influence of the homogeneous mass society which is ruled hegemonically by the visual communication media, it is important that parents and family in the early stages of development and, at a later stage, teachers, and learning institutions assist the individual to develop curiosity, alertness, awareness, and interest in different issues, topics, phenomena, circumstances, etc. It is important, for example, for parents and teachers to challenge young minds and turn their attention away from the mundane towards the diversified and the dynamic.

The individual's breaking away from the ***usual*** will enable him/her to see and to experience different points of view. It will make the individual aware of the different sides of the phenomena and the issues. Exposure to as many points of view as possible is the road that leads to new discoveries and awareness. When individuals are challenged and given the chance to experience diversified points of view they form opinions of their own and understand the role they play in the society in which they live. To accurately and objectively judge and interpret, one must be cognizant of all factors involving the object or event to be evaluated.

The recognition and appreciation of television images, like all other areas, requires the viewer's general knowledge in academic, social, economic, political, and cultural matters, media, etc. It is evident that in order to communicate responsibly on an issue one must be aware of it and knowledgeable about the factors related to it. This is seldom the case, however, in complex circumstances as viewing a television program. Ignorance in such areas as (1) the message or content of the program, (2) the medium itself in terms of the visual and auditory choices made by the director to *show* and *tell* the story, and (3) the particular types of viewers the program addresses (including their social status and level of intelligence) will result in misinterpretation of the television images. Do all viewers have such knowledge?

The general knowledge required for the proper interpretation of television messages is provided by studies in many different disciplines. However, the specific knowledge one can obtain today in order to enhance the standards of recognition and appreciation of television images can be found in such fields of study as art (art history, appreciation, etc.) criticism (particularly mass media criticism), communication (particularly visual communication), semiotics, media studies (particularly television and films), to mention only a few. Students of visual learning must be aware and fully knowledgeable of these fields.

The standards for recognizing and properly interpreting television images are drawn from the findings of all these studies. Television viewers who do not acquire such knowledge do not have solid standards of interpreting televised images. The global village society does not encourage its individuals to obtain both the general and specific knowledge necessary to build the standard of recognition and appreciation of television images. Visual learning which provides such knowledge, it is hoped, will fill this vacuum.

2. *Viewer's Expertize and Confidence*.

Television viewers standards for recognition and interpretation of visual and auditory elements that compose the pictures are also based upon their expertize in the construction of visual images and their confidence of themselves as individuals. These two factors are combined because a basic and crucial contributor to one's own confidence is the acquisition of expertize.

The average television viewer, of course, does not posses expertize in television production techniques. But constant (high level) exposure to television enhances viewer's understanding of how television works in producing the images and sounds of televised messages. On the other hand, low-level viewers who watch television sporadically can claim less understanding and knowledge of how the medium works. Viewers who have learned how to think visually, by learning how to draw pictures or by formally studying the media, are considered more skilful, with expertize, and more confidence in their cognitive task of recognizing and commenting more readily on television images.

Today's mass availability of home video cameras has turned the majority of people in technologically developed countries into moving image makers and experts in interpreting visual and auditory messages. Such video camera availability in the homes of a wide variety of individuals has strengthened their confidence not only in handling the image making tools properly but also in judging how the image maker manipulates the shots to arrive at the intended visual message.

It is necessary in the primary and secondary education levels for visual literacy to be a major part of the curriculum, considering that as residents of the global village we acquire our information mostly through television. We must provide students with the expertize and confidence needed, as viewers of televised messages, with the appropriate standards for such a cognitive activity.

3. *Viewer's Values, Beliefs, and Motivation.*

The appropriate recognition of moving images and the final meaning we assign to them are highly influenced by our own values, beliefs, and expectations which are cognitive operations stemming from our exposure to the society we live in. We form our opinions of how much it is worth our effort to engage in an activity or how important one program is to watch over another, etc. On the basis of these values we judge, comment upon, or even act throughout our lives. When such values are wrongly formed due to environmental, cultural, religious, political, pedagogical reasons our standards for judging are shattered and misinformed. Forming the appropriate values is not an easy task and we spend our entire lives working towards that goal.

Alongside the values are the beliefs we form on phenomena we assume to be real and truthful. Beliefs seem to be of greater value and individuals seek those figures (political, religious, academic, etc.), institutions, or movements which help them form certain beliefs. Human activities are guided by beliefs which consciously or unconsciously constitute the bases that form the standards for our decisions and generally our cognitive processes. Recognition and appreciation of televised images are based on the beliefs we have formed on the picture elements we watch.

As expertize and skills build our confidence so does motivation build one's ability to engage in the process of critical viewing, comprehending, and interpreting television images. Accurate recognition and proper interpretation of television pictures is not a passive activity as once thought to be. Viewers who watch a dramatic program, an interesting information program, or a catastrophic event are totally motivated and for one reason or another are totally drawn into the program. The emotional state or mood of viewers determines the degree of their motivation to watch and appreciate a television program. Consequently, a basic factor, a standard for the accurate recognition and proper appreciation of television images, is motivation or the willingness to engage in such a cognitive activity. A television show with a significant subject, an artistically staged play (in accordance with the rules of television images composition), and a clearly defined audience (to which the show addresses itself) will be successful and will most likely motivate viewers to watch it (Metallinos, 1973).

B. Understanding of How Society and Institutions Work

Another standard for the accurate recognition of the message in a given television program is the individual viewer's knowledge and understanding of how society and institutions are formed, how they function, and how the individual relates to them.

Visual communication media such as film and television are institutions created by individuals who work under the rules, and regulations provided by society and the particular country. As a creation of a society, media strictly reflect the values and beliefs, political, cultural, economic, religious, etc. of the people of that society. The institutions, arts, and media arts created by a society should reflect the value system, philosophy, ideology of the people of the society. They are the modifiers and reflectors of that society (Read, 1970).

Media arts of a particular society are created to serve at least three major purposes: (1) to illustrate the basic values and beliefs of the society, (2) to promote the society's basic philosophies, and (3) to fulfill the needs, aspirations, and desires of the people of the society which could be emotional/psychological, ideological, etc. Whereas conventional sociologists theorize that the media and arts produced by the media of a society are simply institutions such as schools, courts, churches, etc., contemporary media scholars and sociologists of mass culture suggest that such is the hegemonic power of the mass media in some contemporary societies (i.e., North America) that they shape the society rather than be a part of it. The power of the media as conglomerate institutions is as such that they dominate, often dictate, impose, and even set the agenda which society is forced to adopt and to follow. It is, therefore, obvious that the understanding of how society and institutions work is a prerequisite for the cognitive process of assigning appropriate meaning and accurately translating televised messages. In this section we examine briefly (1) how the mass media reflect the values and beliefs of North American societies, (2) how they propagate these beliefs, myths, and philosophies, and (3) how they manage to fulfill the needs, dreams, and expectations of North Americans.

1. *Media and Society in North America.*

Due to the predominant role of the media in the United States and Canada, these countries have been characterized as media, information, and mass societies of the electronic age, and the like. They are the perfect paradigm of McLuhan's prophecy (McLuhan & Powers, 1989) of the Global Village. It is imperative that as citizens of these countries we realize that the more we depend on the mass media for our information, education, entertainment, etc., the more we become victims of the monopolistic ideology of the producers of these media.

Availability of information offered by easily accessible media technology tends to turn us all into homogeneous, one-track minded, so-called couch potatoes if we are not selective. We must be aware of this danger and we must realize how some powerful institutions can supersede the democratic systems governing the people of our societies.

Mass media in North America might work under a democratically free system but they have the tendency, like the totalitarian systems, to impose upon their viewers symbols, codes, ideas, signifiers, and ideologies which do not necessarily reflect society's real concerns and do not have its consensus. Instead, they impose their own points of view. This has been a grave problem in North America, particularly during the last fifty years since the establishment of network television, the information explosion, the advent and the widely explosive application of computers in visual communication media technologies.

The most advanced countries of the world, the United States and Canada, with the most informed citizens, also have the most vulnerable and defenseless masses of people against the power, influence, and commercially oriented propaganda of mass media. Low income, ethnic minorities, and even main stream middle-class heavy television watchers constitute the majority of viewers in these societies, decisively influenced by what they watch and learn from television, including such important decisions as voting for representatives and heads of governments.

In short, the danger in North America is that the monopolistic and manipulative power exerted by the mass media on the majority of the people of these societies will surpass the guiding and governing role of the society. Instead of the media reflecting society and communicating its institutional values and beliefs, the media set the agenda and shape the rest of the institutions to such an extent that they become synonymous with society. This factor constitutes a standard in the cognitive process of televised picture communication and should not be overlooked by students of visual learning.

2. *Media Myths and Beliefs in North America.*

This section examines what specific tactics are employed by the mass media to achieve their influence and control.

The common tactics of persuasion and propaganda use various means such as repetition, rhetoric, suggestibility, symbols, subliminal messages, etc. Some of these tactics used by commercial television in North America, mostly commercial and cultural myths, will be briefly examined. The subjects of persuasion, attitude change, political propaganda, etc. will not be discussed here. They have been studied in various other fields such as psychology and political science and have shown how successfully the mass media have used them through the centuries (Brown, 1963; O'Keefe, 1990).

Advertising dominates all commercial and business propaganda in North America with persuasion tactics used by the media and employed by businesses. The powerful economies developed in North American societies owe their success to the free market system which encourages competition and is stimulated by sophisticated and aggressive mass media advertising.

Television itself, as an institution and a medium of communication in North America, was developed as an advertising

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medium and this is a fact that should always be remembered. The three most significant factors regarding the persuasive power and decisive influence of network television advertising in North America are as follows:

First, commercial advertising in American and Canadian network television is generally slick, better looking, more interesting than the subsequent television programs. Advertising agencies and television advertising producers, realizing the importance of persuasion and having experienced the successful results of commercial network television advertising, spend more money, hire competent and knowledgeable writers, producers, directors, and generally apply all the appropriate rules of visual communication media production.

Second, commercial advertising in network television in North America is concise, compact, confined only to the precise persuasive goals set forth by the particular ad. Seldom does a commercial network television ad of a significant advertising agency fail to reach its target audience or extend its persuasive visuals and sounds beyond the absolutely necessary. In 10, 20, 30, or 60 seconds, depending on the decided length, the message is clear, the visuals impressive and distinctive, the sounds carefully selected to match the visual composition, the framing, editing, set, etc. all carefully applied and concisely interwoven.

Third, television commercials reach a great range of audiences and successfully fulfil their dreams and expectations. Unlike regular television programs which by necessity can appeal only to a certain category of viewers, the average North American network television viewer is exposed to a large number of television ads which fulfil a great variety of the viewer's psychological needs, desires, etc. Advertising influences viewers attitudes and cognitive process of assigning meaning to televised messages.

The creation of myths, defined as "...a fable or legend of natural upgrowth, embodying the convictions of a people as to their goals or other divine personages, their own origin and early history and the heroes connected with it..." (*The New Webster's Dictionary*, 1965, p. 556), is yet another cultural indicator deeply rooted in the subconscious of regular commercial network television viewers in North American society. Created either by regular, dramatic, or popular television programs, information related television shows such as newscasts, magazine programs, international talk shows, or television commercials, myths are effective persuasive factors deeply influencing the cognitive process of television viewers.

An example from existing literature on dramatic television series and newscasts will confirm the decisive role media myths play in determining the standards for recognizing and assigning meaning to televised images. In his analysis of the then popular dramatic and prime time ex-television series *The Waltons*, Roiphe (1979) suggests that by watching the show the American people created the myth that all was well in American Society just as all was well with the members of the Walton family. Therefore, the mythical world of *The Waltons* offered an escape from the real, cultural, political, economic, and other issues of American society's real life. Roiphe (1979) admits that the creation of myths by popular television programs has some positive aspects to it particularly in providing a break from the realities of life. But he warns that: "It could be said that these myths torment us, describing role fulfillments that aren't there, promising marital peace that never arrives and forcing us to stare at the pitiful discrepancy between what is and what we would want" (p. 14).

In his article "Kaptain Kronkite: The Myth of the Eternal Frame" Curtis McCray (1979) explains how North American network television viewers who watch various popular television programs for a considerable number of years create

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mythical heroes of the major characters of these programs who provide entertainment, information, solutions to serious problems, reassurance, confidence, etc. through the television frame. The heroes of the then two popular programs *Captain Kangaroo and The CBS Evening News with Walter Cronkite* gained mythical dimensions with their appearances on the frame. Their behavior and the program's format deeply influenced the cognitive process of viewers Commenting on this issue McCray (1979) states that:

> While I would make no claims for the ultimate artistic greatness of CK or WK, I would argue that formally the shows do tap us somewhere deeply in the recesses of our cultural consciousness. Or, to return to the original question of this essay, I do believe commercial television is engaging man in the gravity of his own self-perception-the epic has always done that. (pp. 332-333)

The myths and heroes created by various television programs help commercial television North American viewers create their values and form their beliefs in accordance with the patterns and examples given by television characters. Our cognitive decisions on matters related to television pictures are highly influenced by such media myths and beliefs.

3. *Media Fulfillment of Viewers' Needs, Dreams, and Desires.*

Other contributing factors to the establishment of the recognition standards of television images are viewers needs, dreams, and desires that various television programs fulfill on different levels. This important factor has a long history and is deeply rooted in the subconscious of people of all cultures. People of a society and a specific culture create their art forms such as music, dance, poetry, theatre, etc. in order to (1) express themselves as artists, (2) reflect their societies values, and (3) fulfill various psychological needs and desires. The psychological functions of the arts in providing the means by which people can rid themselves of inner fears, guilt, sorrow, etc. and can be inspired, motivated, and fulfilled as well as informed and educated, was first pointed out by the ancient Greeks. Modern psychologists such as Aronoff (1967), Freud (Jones, Prince, Strachey, & Strachey, 1959; Strachey, 1960), and Maslow (1954) have given us scientific proof of what was known to Plato and Aristotle some 2500 years ago. Contemporary media scholars, particularly television program analysts (Adler & Cater, 1975; Novak, 1979; Wood, 1979; etc.), established quite accurately the role that various television programs in network North American television play in fulfilling the needs and desires of a great number of people. Certain examples of these works will be provided.

Plato and Aristotle were the first to point out the emotional/psychological effects of the arts, and in particular music and drama, on spectators. Plato suggests that spectators listening to a rhapsody or watching a drama are often fearful and deeply involved. This, Plato suggests, could be dangerous (Dickie, 1971). Aristotle, a student of Plato, in the *The Poetics* not only acknowledges the emotional/psychological effects that drama in all its forms has on the spectators but suggests that the function of a good drama is to stimulate the spectator so deeply that the action on stage will provide emotional release through crying or laughing, termed "emotional purgation" (Dickie, 1971).

On the basis of Maslow's (1954) theory of personality, Aronoff (1967), his student, developed the theory of psychological needs fulfilled by the cultural activity of a society of which media arts is a part. The Maslownean (1954) hierarchy of needs, thoroughly developed in his book *Motivation and Personality* reached five levels: (1) physiological such as hunger, sex, thirst, etc., (2) safety, such as fear of death within the family, fear of physical assault, (3) love and belonging such as the need to love and to be loved, the need to feel that one belongs to a family, etc., (4) self-esteem such as the need to acquire strength, dominance, recognition, etc. in a society, thus gaining prestige and self-esteem, and (5) self actualization such as the need to exploit one's talent, capacity, potential, skills, etc. (Aronoff, 1967). To the various levels of the needs expressed above by Maslow (1954), Aronoff (1967) added many others stemming from psychology and sociology related to the arts and culture of the people of a society. In short, Aronoff (1967) suggests that all cultural systems and human institutions provide the bases upon which the psychological and social issues are explored and therefore concludes that the media arts of the society are created to meet these premises.

Finally, contemporary media analysts such as Nova (1979), Wood (1979), etc. suggest, quite convincingly, that network North American television programming either acts as a dream for the spectators or fulfills the dreams spectators might have for a better life, luxury home and car, prestigious job, etc. The great variety of television programs today offers both dreams of living vagariously while watching exotic places or people and dreams that take one away from reality for as long as one is engaged in watching television. In either case, television programs fulfill this basic psychological human need, as they do with the entire spectrum of such needs as seeing authority figures either exalted or dishonored, evil punished, and virtue rewarded. The list is as endless and as vast as are the human emotions, psychological desires, and aspirations of every spectator of television pictures who expects to be fulfilled. Hence, television programs reach the individual with the dispositions of fulfilling their dreams and satisfying their needs and desires.

C. Study of the Process and the Effects of Visual Communication Media

In addition to personal awareness, knowledge, and expertise (described in section A) and an individual's knowledge of how society, institutions, and media work (discussed in section B), the development of the standards for the recognition and appreciation of television requires study and familiarity with the technical aspects of the medium (its hardware) as well as the artistic aspects of the medium (its software). The fulfillment of this prerequisite is extremely crucial because it focuses directly on the medium's two most important areas of study, its processes and its effects and helps us to acquire the value judgements most appropriate for the technical and the artistic evaluations of televised images.

This section discusses briefly (1) the technical aspects known also as process of the television mediums, (2) the artistic or compositional aspects of the medium, and (3) provide an inclusive list of criteria for the evaluation of an educational television program.

1. *Technical Aspects of Television Images.*

What characterizes a visual communication medium and distinguishes it from any other are the picture components it uses: the television cameras, microphones, switchers, lights, and editors are the specific *hardware*, the tools that television medium utilizes to produce its visual messages. Obviously, students of visual literacy must know how these tools work and what their potentials and limitations are. If, for example, a painter does not know how to mix colors or use a brush, how could he/she claim to know about painting? Equally, students of visual learning, particularly of television images, must know how the hardware of the medium work in order to produce television images. The foremost academic study dealing with this is television production.

In addition to the knowledge of the hardware of visual communication media, scholars of the aesthetics of television suggest that the *substance* or materials of the television medium which differ decisively from those of other visual communication media such as film or photography, must be studied separately and systematically (Metallinos, 1979; Tarroni, 1979; Zettl, 1990). The substances from which television images are made of are lights and colors. Consequently, the study of lighting instruments and their subsequent lighting control systems is an important prerequisite for the study of television production and visual learning. The fact that the television picture is made of light not only distinguishes television from other media, but dictates the particular lighting techniques appropriate only to the television medium. Furthermore, television requires skilful handling of lighting instruments and sensitivity as to what the instruments can or cannot do. This, however, is not always the case with television production lighting engineers, as will be discussed herein.

The third important factor that distinguishes the medium of television (technologically) from other visual communication media is the *production techniques* it uses to create television images. The unique way by which the lighting engineer handles lighting instruments to create a particular mood of a scene or the way the camera operator frames the picture for a dramatic moment of a scene; the way by which the editing was decided by the director, or the different ways by which the engineer handles the sounds for the particular scene all constitute the techniques most appropriate for the medium of television. Lighting, framing, editing, or audio techniques for television should not be the same as those used by theatre, photography, or film. They are different because each medium has developed its own production techniques.

To the knowledge of unique hardware, substance, and production techniques of the medium one must add the need for a detailed understanding of the four most prominent components (all in the area of the hardware) of the television medium. These are: (1) light and lighting techniques, (2) cameras and framing or staging techniques, (3) time-motion and editing techniques, and (4) audio techniques. In television production the learning of these four components constitutes the bases of the study of the medium. In visual learning the systematic study and knowledge of these components are important, as the examples hereunder emphasize.

The manipulation of the television lighting instruments to create prominent attached or cast shadows is what television lighting is all about. Learning, therefore, which lighting instruments (directional or diffused) to use, where to place them (i.e., above or below eye level or at what angle), and with what intensity (required number of foot candles) in order to create a high key lighting technique or a daytime scene is obviously closely related to picture recognition and appreciation.

The manipulation of television space (both negative or empty and positive or occupied space) is what constitutes television framing and staging techniques. It is necessary therefore to know where to place the objects or stage the action (positive space) and where to place the cameras in relation to the objects (camera position and angle), the distances allowed for subject (primary) and camera (secondary) movements which depends on the potentially available negative studio space, all determine how the picture is framed by the television camera operator, and this, in turn, will enhance television picture recognition and appreciation.

The manipulation of televised images in regards to their sequential appearance is what television editing is all about. Learning, therefore, which shot was chosen (long, medium, close-up, etc.), by which camera (visual direction), at what time (point of interest and punctuation), etc. are significant factors for the proper flow of information. This is a crucial factor for the recognition and appreciation of televised messages.

Lastly, the manipulation of sounds and the audio components used to match the visuals that accompany them is what television audio is all about. Learning how each microphone works (omnidirectionally, unidirectionally, etc.), where to place the particular microphone for maximum sound pickup, how to select the appropriate sounds visually compatible to the picture's synthesis (matching criteria for pictures and sounds) are all important factors in the construction of televised images and are significant and mandatory knowledge for the proper recognition of television pictures.

In summary, the study of the technologies used and the techniques applied by the visual communication medium of television provides the bases upon which the standards for picture recognition in particular, and visual learning in general, should be built.

2. *The Artistic Aspects of the Television Images.*

One of the basic and most crucial prerequisites for proper recognition and appreciation of television images is their analysis as art forms. All art forms, regardless of the category under which they fall are difficult to study due to their complexity. The study of television as an art form is even more difficult for various reasons. There is a great deal of confusion in North America as to what network, educational, and video art television are. We call everything *television* when we must differentiate various categories of it since each one has created several types of programs or production formats which must be analyzed on their own merits. Therefore we must first distinguish these three forms of television. The medium of television, regardless of its category, is a considerably new medium and today there are a limited number of empirical studies dealing with the artistry of the medium (Metallinos, 1985; Newcomb, 1982). This lack of vigorous scientific research on the compositional factors of television has considerably delayed the development of those particular compositional principles governing the production of television images. Yet another reason which made the study of television as an art form difficult was its commercial or business origin, its mass communication scope, and the thought that television was an advertising device. This business concept dominated the television industry and effected all types of television programming by shaping both the content and its form of presentation.

Serious efforts have been made, however, during the last ten to fifteen years to establish the bases on which television, particularly the educational and video art categories, can be studied as a unique art form with its own merit. Excellent texts on television production (Millerson 1972; Wurtzel, 1983; Zettl, 1992; etc.) have been published which provide detailed information on both the hardware and software of the medium. Empirical studies on factors related to various components of the television medium (Fletcher, 1979; Kipper, 1986, 1989; Metallinos, 1979; Thorburn, 1987; Tiemens, 1970; etc.) have been published in the journals of our field which look at the compositional value of television lighting, staging, editing, and audio and various descriptive and critical studies on the compositional structure of television pictures (Newcomb, 1979; Tiemens & Avery, 1975; Zettl, 1990; etc.) have been published as books, articles, or conference papers which look at the television program as an art form.

This section examines the artistic or compositional aspects of television known also as the medium software and concentrate primarily on the unique features of television and the primers of television art literacy. What makes television unique as an art form? What is the nature and the idiosyncrasy of television? Although television categories (i.e., network, cable, educational etc.) have developed their own unique features and each type of program within each of these categories (i.e., soap operas, detective shows, high drama, etc.) has created its own unique characteristics, we can generally identify some features common to all categories.

Television as an art form produces programs for *simultaneous mass audience appeal*. Even video art programs which experiment with both various hardware and software of the medium, are transmitted simultaneously to a great number of viewers. This fact dictates the content and outlines the form of program presentation which places it in the broader category of the popular arts. This is a unique feature of television as an art form.

Another unique feature is the *threefold synthesis* of its pictures which consist of visuals, audio, and movement, all of which work harmoniously to evoke viewers emotions. Although films also consist of sights, sounds, and motion, television differs from film in that it can present this threefold synthesis of the pictures electromagnetically and live. The television picture and in fact the entire television program is composed while in motion, the moment it occurs.

Several observers of the television medium as an art form have suggested that what distinguishes television from other media collectively are its "small size," its "immediacy," its "intimacy" (Millerson, 1972, pp. 198-202), its "viewing intensity" and "viewing involvement" (Toogood, 1978, p. 16). The programs produced by any category of television are art forms which are given to people who view a small vista screen, are directly in front of it, get deeply drawn in the action and become totally involved with it (Antin, 1982).

The most emphatically distinct feature of television as an art form is its *metamorphic nature* by which images are synthesized to tell the story. The juxtaposition of the television images occurs while undergoing constant change The images, accompanied by appropriate narratives or sounds, are in constant flux changing from long shots to extreme close-ups, sometimes expanding, other times swinging, often flipping over, etc. Only live television can achieve this. The art forms produced by television which utilizes such features are unique. In assessing and evaluating this unique characteristic of the television medium art, Zettl (1978) states:

> When television is used to *create* it simply grabs from external reality the bits and pieces it needs for this creation. When performing this function television becomes metamorphic. It no longer translates, but transforms, yes, even transcends the raw materials of external reality into an event that cannot exist outside the medium itself. (p. 7)

Let us turn now to the specific new television materials that constitute the primers of the art of television and provide the television literacy in our quest for visual learning: Arnheim (1969) in his *Art and Visual Perception* and Dondis (1973) in her *A Primer of Visual Literacy* give us the basic new materials and elements that compose all visual arts. For Arnheim (1969), a gestalt psychologist, the basic elements of the visual arts are balance, shape, form, growth, space, light, color, movement, tension, and expression. Paintings, sculptures, architecture, film, photography, music, theatre, etc. all have these compositional elements in their synthesis. Their artistic analysis and aesthetic evaluation should be based on the proper syntheses of all these elements. For Dondis (1973), the raw materials in the synthesis of the visual arts, also known as the *primers* of visual communication arts, are the dot, line, shape, direction, tone, color, texture, dimension, scale, and movement. The analysis and aesthetic evaluation of any visual art form should be based on the way these elements are organized to create the art form.

In addition to these materials, most of which are interwoven with the television image, the artistic evaluation of television programs should be based on the way the picture's visual elements are created and composed. They fall into three categories corresponding to the threefold nature of the television pictures: visuals, sounds, and movements. In the first category the lights and colors constitute television's primers and occur either as chiaroscuro lights (characterized by their distinctive darkness or lightness of the cast and the attached shadows that are created by television's directional or diffused lighting instruments) or as flat lights (characterized by the overall, unified brightness and evenly distributed light on the scene). Television colors occur either as prime colors (blue, red, and green) from which all other combinations of colors are achieved or as additive and subtractive colors created by various primary and secondary color combinations. The artistic quality of television pictures obviously depends on the proper usage and synthesis of these primers to the entire television program.

Various visuals created by the television camera and manipulated by the television switcher or special effects video synthesizer also constitute the primers of television literacy and occur in different forms. They appear as long, medium, or close-up shots depending on the narrative form chosen by the director. They are matted, chromakeyed, split-screened, zoomed in or out, etc., again depending on the audio truck and the story they unfold. All visual special effects created by video synthesizers such as fades, dissolves, wipes, superimpositions, etc. constitute the primers of television literacy and are the fundamental elements that compose the television art form.

In the second category of sound such basic sound elements as literal (i.e., sounds derived from the source that creates them such as waterfalls, airplanes, etc.) or non literal (i.e., music sounds, such as violins imitating the sound of autumn leaves falling, etc.) constitute the primers on which the analysis of the television picture and programs are based. Also, such elements of television sounds as pitch, timbre, duration, loudness and attack-decay or such basic sound structures as melody, harmony, homophonic and polyphonic, or picture sound combinations either homophonically or polyphonically structured, and picture sound matching combinations either thematically, tonally, rhythmically or historically are the most basic, fundamental elements that compose television art forms (Zettl, 1990).

The various perceptual motions such as real, apparent, and implied as well as particular movements that take place when a television program is videotaped such as the motions of the subject and the camera, and the motion created by the flow of the action within the visual field are the motion primers of television programs as art forms. They constitute television literacy. To these various types of motions in television pictures the roles of slow and accelerated motion are significant because they make television a unique medium. The ability to accelerate, slow down, and replay moments of the past are not only unique primers of television but help to underline the structures of television programs.

In summary, the study of the primers of television found in either images, sounds, or movements of visual elements provides the necessary criteria for the evaluation of television programs as art forms. The study of the artistic aspects of television based on the knowledge of the software of the medium is a prerequisite for the establishment of the appropriate criteria for the accurate recognition and evaluation of televised images.

3. *Established Criteria for the Evaluation of Education Television Programs.*

Based on existing literature on television criticism (which includes several well written books, research articles, and conference papers) extracted from critical studies on related fields such as theatre, visual arts, film criticism, etc. a list of value judgements or applied criteria for the evaluation of educational television programs is constructed. Before referring to this inclusive list of criteria three major compositional principles which apply, unilaterally, to all art forms will be underlined. A definition and explanation of what an educational television program is will also be provided in order to make the criteria list more explicit.

The compositional principles underlining all art forms, regardless of their nature or form of presentation are *direction*, *proportions*, and *balance*. Critics of the performing, visual, and media arts evaluate art fonns on the bases of these three elements inherent in all.

Direction refers to the way the flow of action moves. It could be from left to right in the case of a moving image, or from morning to night in the case of a theatrical story. The established direction determines the flow and continuity of the art form. The events of a theatrical play, like those on a television screen follow or should follow an established direction which, in turn, establishes continuity which is the foundation of the art form. Disorientation resulting from lack of direction causes confusion and breaks down the communication process.

Proportions refer to the way artists adjust various parts of the art form to make them symmetrically or asymmetrically harmonious. Art forms are proportionally divided by the artists in their effort to make the form attractive, etc. A dramatist divides the dramatic form into acts with portions of plain dialogue or high conflict; a painter divides the canvas into areas depicting intensive action and areas of background visual information; a television camera operator, at the will of the director, divides the television picture into areas of prominence (foreground figures) and others with secondary importance (background) elements. A good work of art is aesthetically pleasing when proportionally divided to harmonize its various parts.

Balance, the third basic principle found in all art forms, refers to the degree of stability produced by the distribution and interaction of various parts of the art form and results in an aesthetically pleasing composition. According to Arnheim (1969), "An unbalanced composition looks accidental, transitory, and therefore invalid" (p. 12). Balance as a compositional principle can occur either as unstable, stable, or neutral, depending on the particular art form. In television picture composition all three forms of balance can be found interchangeably since television pictures are transitory and metamorphic and create an even greater challenge to the producer/artist of televised images.

Educational television programs do not necessarily refer exclusively to those programs produced by such educational television networks as Public Broadcasting Service (PBS) in the United States, Canadian Broadcasting Corporation in Canada (CBC), etc. The term refers to all television programs whose central theme is to present topics referring strictly to education and others produced by individual education stations, networks, or organizations such as the National Geographic Society, etc. Such recently televised programs as *The Civil War* or *Nova* are the most representative of the educational television programs referred to here. Although these programs place a strong emphasis on their central theme of learning and encyclopedic information they are written for, produced by, and presented via television. Consequently, the criteria for their evaluation are both specific, referring exclusively to their educational genres and general, referring to television programs as an art form.

The list of criteria provided below is divided into three major areas in accordance with the three most important functions or purposes television programs serve to explore the issue, present it, and reach a targeted audience (Metallinos, 1973).

A. Criteria Concerning the Content or Message

Although not exclusive, the basic criteria for discussing, analyzing, and evaluating the issues explored by an educational television program can be as follows:

1. Content/message significance and importance.
2. Accuracy of ideas and documentation, research.
3 Writing style and format.
4. Composition and dramaturgy of story.
5. Order and balance of segments.
6. Simplicity and complexity of treatment of the story
7. Pedagogical impact and importance of the message.

B. Criteria Concerning the Medium or Form

The medium shapes the form and creates the art as a communicative agent. The criteria for the evaluation of an educational television program should be based on the two factors, production and performing, as follows:

1. *Production Factors.*
    a. Lighting technique usage and effects, colors, and visual clarity.
    b. Cameras, lenses, effects, framing, staging, space utilization, and background/middle-ground/foreground interrelationships, screen composition, setting, etc.
    c. Pace, motion, rhythm, editing techniques, special effects, graphics, image continuity.
    d. Audio sound clarity, sound consistency, and coherence. Audio perspective, matching visuals with sounds, audio-visual reinforcement, audio visual balance, etc.

2. Per*forming Factors.*
    a. Performer's appearance, clothing, colors, etc.
    b Age, sex, character choices.
    c. Body movements, stage (or camera) presence.
    d. Eye contact, lens acting, naturalness.
    e. Character interpretation and fitness within the context of the program.
    f Delivery and believability of characters, etc.

C. Criteria Concerning the Program's Impact/Effects on Viewers

The third important purpose of the educational television program, as is the case with all television program formats, is to stimulate the audience and to cause reactions, to have an effect upon them which is closely related to the message. Such criteria can be as follows:

1. Audience identification. Who are the viewers?
2. Does the program fulfill its intended scope?
3. Audience reactions. Do they like it? If so, why? If not, why not?
4. Overall importance, significance, usefulness of the program to the target audience and to society at large?
5. Is the program tasteful? Does it contain violence, conflicts, models, or concepts that should not be aired?
6. What specific public needs does the program fulfil? (i.e., sociological, aesthetic, psychological, physiological, etc.).
7. Innovation--to what degree is the program different? etc.

In summary, the criteria for the evaluation of educational television programs should be drawn from the three main purposes of the program: the message, the medium, and the viewer.

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An Analysis of Clarence White's Photograph, "The Ring Toss"

by

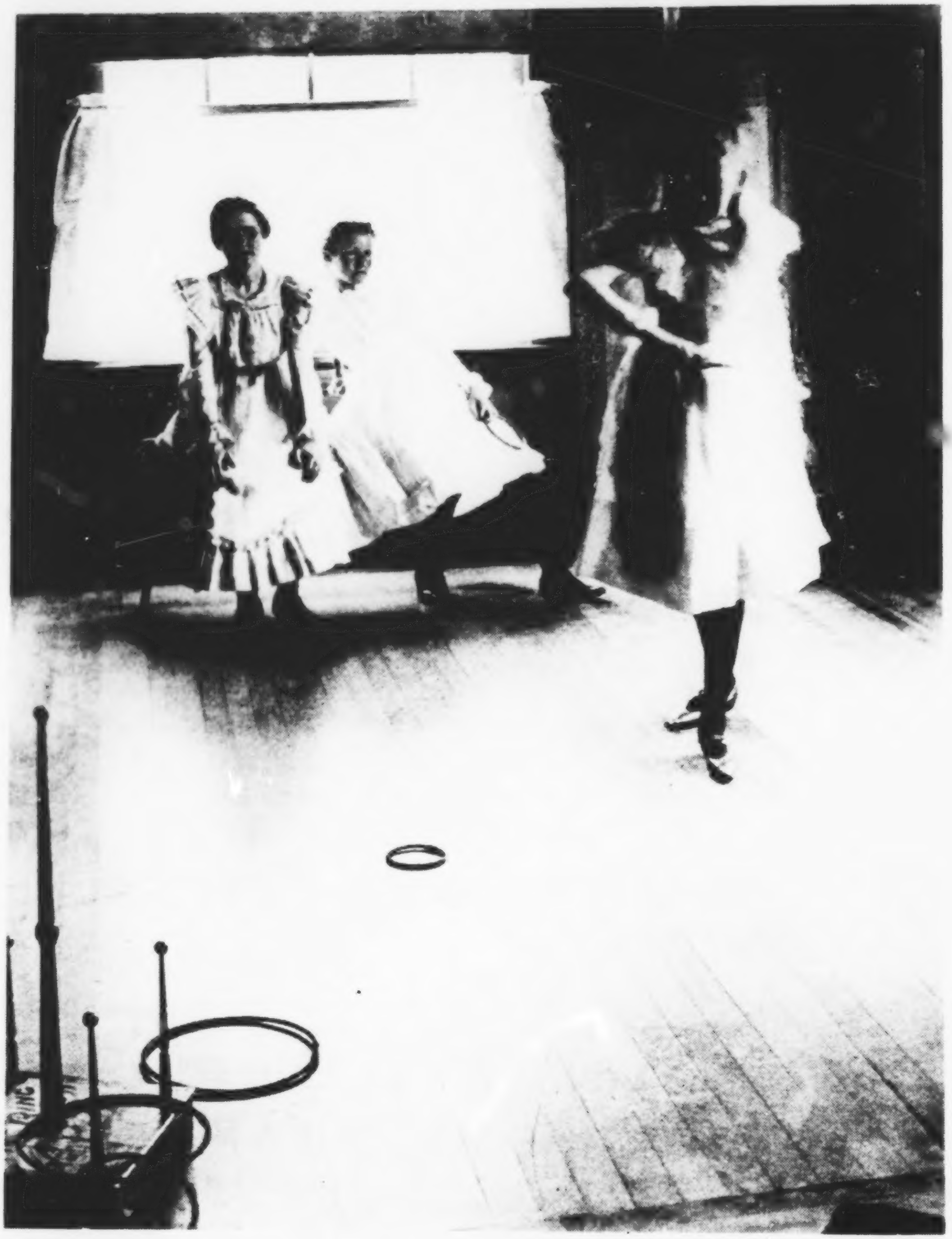
Charles Lewis

The Ring Toss, a gum-print photograph produced in 1899 and first published in a 1903 edition of *Camera Work*, has become one of photographer Clarence White's most noted images (see Figure 1). In scholarly works detailing White's career, pictorial photography, or the early years of the Photo Secession, one often finds a full-page reproduction of White's *Ring Toss* standing as a sort of epitome of soft focus or 'fuzzy' pictorialism — a particular strand of American art photography most practiced around the turn of the century. This article is an analysis of White's *Ring Toss* in particular and 'fuzzy' pictorialism in general, using methods of the "discipline" of material culture oulined by Jules David Prown as well as historical and sociological study.[1]

The central question this article addresses is why so much late Victorian art photography centered around 'fuzzy' images of genteel women and children in leisure settings. Through an historically and sociologically grounded analysis of the photograph's form and content, White's portrayal of gender and class identity in *Ring Toss* will be discussed and related to larger social and cultural issues concerning class and gender in the late nineteenth and early twentieth centuries. Central to this discussion is the relationship between painters and photographers during the late Victorian era as well as the relationships of both groups of artists to American society and culture. To the late twentieth-century viewer, *The Ring Toss* may look static, overly constructed and ripe for a Freudian psychoanalytic-oriented reading: Three virginal young women, located in the undeveloped sexual environment of adolescence, throw ovarian/vaginal-like rings at phallic rods. They are playing or experimenting with notions of sexuality and gender relations — the ring toss is a metaphor for an element of the sexual tension between males and females. The nearly empty room symbolizes their as yet undeveloped libidinous state. The softness of the print indicates the dream-like metaphoric nature of the image's meaning.

Such a reading could have little to do with the meanings originally attached to the photograph in its late nineteenth-century context. When one considers historical and sociological factors, White's *Ring Toss* can be related to upper middle-class Victorian notions of childhood, leisure and gender identity. It is also a particularly revealing artifact concerning the development of art photography in America. While sexual tension may well be a part of White's image, the point of this article is to address social rather than psychoanalytic factors related to the image. The context of image production and reception is central to this article.

Figure 1



Clarence White, *The Ring Toss,* 1899

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One striking element of White's six-by-eight-inch photograph is that it is a rather close imitation of William Merritt Chase's 1896 painting, *Ring Toss* (see Figure 2).[2] It is obvious White's ideas for the basic form and content of the photograph were not original. Chase's free brushwork is paralleled by White's use of the gum print process to soften features. The use of compositional space and tonal gradations is similar in both works, as is the subject matter — three prim girls, dressed in white gowns, playing ring toss in a large, open room.

There are, however, important differences between the Chase painting and White photograph. In the Chase painting, the girls are framed by what appear to be two different sized artist's canvases, one on a wheeled pedestal. The room is apparently a studio painter's work space — perhaps a part of Chase's Tenth Street Studio. Heavy drapery covers much of the background. In the White photograph, the girls are posed differently — two are seated in front of a large, luminous window with bright sunlight diffused through a sheer curtain. The ring toss game is partially out of the frame. The purpose of the room in White's photograph is more difficult to understand because the only discernible objects in it are a room divider off in one corner, a bench and the game pieces. The differences do not imply much of a sense of originality on White's part, but indicate the influence of other artists, particularly James Abbott McNeil Whistler, as well as the determinism of working within the particular medium of photography.

The form of White's *Ring Toss* dominates — shapes, tones, patterns of light and space interact to form a soft and delicate composition stressing asymmetrical balance. The genre-oriented content of the picture seems almost incidential. Despite most of the foreground being open space — a bare hardwood floor — balance is achieved through anchoring one corner of the foreground with part of the dark-toned ring toss game, the rest of it being cut out of the frame. This corner of the foreground is linked diagonally to the standing girl in a rather luminous white dress who anchors the upper right corner, along with deep shadows in the extreme background. The standing girl and the game in the lower left corner are linked through her attention being focused on the game and through the rings on the floor leading directly to her, seemingly from the game. The top left portion of the frame is dominated by the merged white shapes of the rectangular of the window and the triangle of the two girls on the bench. Both shapes are surrounded by deep shadows. The eye is drawn to them through the extreme brightness of the window and the leading lines of the floorboards in the foreground. The lower right corner of the print is anchored by an indistinguishable, cut-off black shape. Nothing in the print is sharply delineated.

White's *Ring Toss* is a display of light and form — of tonal variations and shapes. Its off-center design, the cut-off form of the game, the open space and soft tonal gradations indicate influences such as Whistler and his "Japanese-inspired compositional motifs."[3] In the room divider behind the standing girl, it even appears White has added a pattern of butterflies reminiscent of Whistler's butterfly monogram. Like Whistler's mother in *Arrangement in Gray and Black No. 1*, the three girls in White's photograph project no personality or emotion — each "becomes an object among objects." Because the emphasis is on the photograph's formal qualities, it, like Whistler's works, becomes above all a "decorative entity" — it is "art for the sake of art."[4]

White was also influenced by impressionism, in particular the American "tonalist impressionism" practiced by painters such as Thomas W. Dewing and Julian Alden Weir — artists also influenced by Whistler as well as the French barbizon school.[5] Unlike the bright colors of much impressionism, the colors in tonalist works were usually muted — subdued by a controlled tonal range. Tonalist scenes were softened — often rather misty and darkened intimate images of rather immobile people in upper middle-class interiors. Tonalist works evoked particular moods — often a sort of meditative nostalgia.[6] Much of this is evident in White's *Ring Toss*. And just as he 'borrowed' from Chase, it appears White borrowed a specific configuration from Weir. One of the seated girls in White's photograph is posed almost exactly like Weir's wife in his 1888 painting *Idle Hours*.[7] What is particularly striking is how both White's girl and Weir's wife are not only posed similarly with arm outstretched and head canted, but both are positioned in front of a luminous, sunlit window with sheer curtains.

Why did White partake in such an overt form of 'plagiarism' as evidenced in *The Ring Toss*? The changing relationship of the medium of photography to society and the art world in the late nineteenth century provides much of the answer. In the late nineteenth century, using the camera as a tool in the production of art was nothing new. The use of photographs as guides for paintings was an accepted practice. Degas, Gauguin, Lautrec and Americans Thomas Eakins and the impressionist Theodore Robinson were among those painters using "study photographs." Scholars such as Van Deren Coke and Richard Boyle have written how the use of photographs may have helped lead to new conventions in painting such as distorted perspectives; emphasizing candid moments in poses and arrangements of objects; and focusing on light at particular moments.[8] White, however, was not interested in using photography as an aid in the production of paintings or sculpture. As an American pictorialist, he was interested in legitimizing photography as another branch of the fine arts. To him photography was art — it was more than a seemingly accurate two-dimensional representation of reality.

In the late nineteenth century, 'pictorialism' became a general term for art photography.[9] Unlike the burgeoning group of Victorian amateur snapshooters interested in family photographs, the pictorialists used the camera for creative expression. From its beginnings in the 1850s with photographers such as O. G. Rejlander and H. P. Robinson to its solidification around the turn of the century with organizations such as the 1892 British Linked Ring Brotherhood and the 1902 American Photo Secession, pictorialism was a movement deeply influenced by contemporary painting. Pictorialists not only borrowed the subjects and compositions of painting, but felt their work should be judged according to the same aesthetic criteria as painting.

The preoccupation with paralleling painting led many pictorialists to turn to extreme forms of manipulation, such as carefully staging subjects to using the 'fuzzy' gum-bichromate process, in which actual pigment instead of silvers forms the final image. Because so much painting of the time was 'fuzzy' in some manner, droves of pictorialists began producing soft prints. Because the average person expects to see 'sharp' photographs, producing 'fuzzy' images was a clear statement separating snapshooters from the aspiring pictorialists.

But the pictorialists were also influenced by their origins in the broad amateur photography movement which started in the 1880s with technical improvements in photography. Improvements such as dry plates, faster emulsions, celluloid film and pocket cameras led millions of Victorian bourgeoisie to take up the newly simplified medium of photography as a hobby.[10] In this sense, amateur photography in general and pictorialism in particular were a part of the 'aesthetic movement' of the period — that great retreat from the 'vulgar' and 'material' industrial environment to the refined interiors of Victorian homes. Because of this meeting of the bourgeois class and photography in the context of the aesthetic movement, many subjects of pictures were naturally focused on the private sphere — family gatherings, pets, the beach, mothers, children, and picturesque scenery. Many of the pictorialists of the late nineteenth century began as amateurs making snapshots of these private-sphere subjects. When they moved on to more 'artistic' pursuits, they did not abandon such subjects, but, like the painters who were also making images of the private sphere, they idealized them by enveloping them in a concern for formal pictorial qualities.

The reform ideas of the aesthetics movement helped lead to such bourgeois photographic pursuits as carefully planned vacations to photogenic places, art history studies, museum trips and the organization of clubs, exhibitions and periodicals. Between 1880 and 1900, the number of organized amateur groups increased twenty-fold — many were subsidized in some fashion by the photographic industry, Kodak in particular. Several of these amateur groups developed into elitist institutions organized similarly to painters' groups and the organizations supporting painting.

But unlike the mechanisms of 'high art,' the pictorialist organizations, journals and exhibitions were not able to adequately support the photographers. Occasionally popular magazines such as *Scribner's* or the *Century* bought an image for $5 to $15, but few collectors in the 1890s purchased photographs. Still, connections between the pictorialist photographers and painters were occasionally forged through the exhibitions and periodicals of elitist photographic groups such as the Camera Club of New York and the Photographic Society of Philadelphia. For example, in the Photographic Society of Philadelphia's first 'Philadelphia Salon' exhibition of 1898, W. M. Chase was asked to serve as a judge.

Clarence White began producing pictures in this milieu.[11] As a child in Ohio, his interest in a career of painting was discouraged by his parents. After high school, White became a bookkeeper for a grocery firm in Newark, Ohio. He began taking photographs in 1893 — the year of his honeymoon trip to the World's Columbian Exposition in Chicago. He reportedly was fascinated with the works of major artists — Whistler and the American impressionists in particular. The Exposition featured works by each of the future members of the 1897 group, 'The Ten American Painters,' as well as six Whistler oils and numerous etchings.[12] In 1898 White formed the Newark Camera Club, had reproductions of his photographs published in the national periodical, *Photographic Times,* and exhibited at the first Philadelphia Salon. During this time he met Alfred Stieglitz and F. Holland Day. In 1899, the year he produced *The Ring Toss,* 122 of his photographs were exhibited at the New York Camera Club. White eventually became a member of the Linked Ring and helped found the Photo Secession as well as other pictorialist organizations. He eventually moved to New York in 1906 and became a professional photographer and instructor. In his later years, White became a very influential teacher of such documentary and commercial photographers as Dorothea Lange, Margaret Bourke-White, Paul Outerbridge Jr. and Anton Bruehl. Although he was open to alternative styles, he never completely abandoned the 'fuzzy' approach.[13]

In the early years of White's photographic career, most of the images he produced were quite similar to *The Ring Toss*. Produced as either gum or platinum prints, his images always stressed formal qualities such as balance or tone. They were usually 'fuzzy' representations of idyllic, tranquil scenes of his friends and family — usually children or young women. In his images, children and young women play instruments, gather fruit, and stroll through landscapes bathed in soft, early morning light. The women and children are carefully arranged in proper upper middle-class Victorian clothing — they exude a sense of bourgeoisie decorum in pose and attitude. They often appear to float in a dream-like trance through a genteel world.

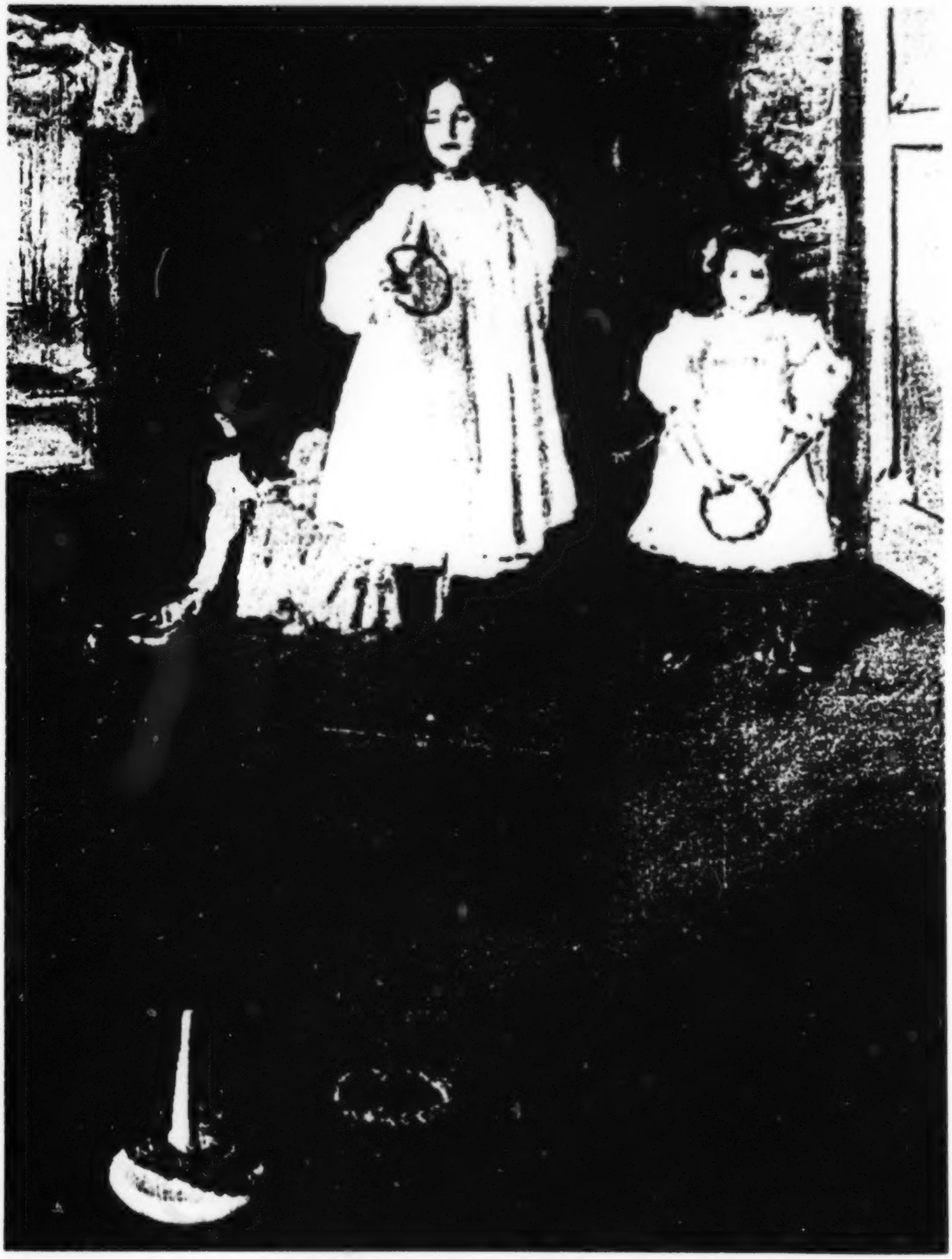
In this sense, White's *Ring Toss* is the epitome of this sort of pictorial work. The three young women are oblivious to the eye of the camera — the viewer is able to glimpse a moment of activity in the private sphere of the leisure class. The girls are engaged in a 'proper' game for young Victorian females. They concentrate on ring toss. The game is not physically taxing, yet it encourages manners and morals through a structure of 'gentle' competition. It is a form of learning how to compete and excel in a leisure-class world. In this sense, the girls reflect their roles in Victorian society. They politely take turns — there is no heated competition. They sit properly while awaiting their turn, and they delicately throw the rings with feet and limbs in proper positions. They are dressed in the purity of white and sheltered from the natural world, which is symbolized by the bright sunlight burning through the window and its curtains. And apparently their parents can afford to leave a room open for such congenial pursuits — prosperity is implicit.[14]

Again, it must be keep in mind that White was working with the ideas of others in *Ring Toss* — particularly Chase's. In other photographs he, like many of the pictorialists, apparently imitated the works of other painters — although none quite so closely as Chase's *Ring Toss*. Therefore, one cannot separate White and many other pictorialists from the painters of the late nineteenth century and the society they were a part of. The late nineteenth century was a time of industrial and economic expansion — of invention, urbanization, secularization and a new national and international perspective. Between 1865 and 1900 the national wealth quadrupled and the population doubled. With the industrial revolution came a cultural revolution. The increased wealth meant cultural advances in art, literature, science and the social sciences.[15] During this period wide circles began to expect art to be innovative — to break the rules of the academy as well as the tastes of popular culture. Such dissenting yet flamboyant artists as Whistler, John Singer Sargent and Chase began to be cherished by the upper classes.[16]

The late nineteenth century was a period when the newly formed and socially dominant bourgeois class turned inward and looked at itself. These privileged Victorians apparently liked much of what they saw. They celebrated their position and reproduced it visually in snapshots, artisitc photography and other art forms — particularly painting. Many of the artists of the period, as members of the privileged class themselves, also celebrated the 'good life' — the bourgeoisie served as the subjects as well as the patrons of this art. Artists like Whistler, Sargent and Chase not only painted the leisurely, monied life, they lived it as well. And it appears photographers such as White and Stieglitz were as interested in becoming part of the 'high-art' leisure class as they were in producing photographic art. Thus, leisure became respectable — a badge of success. Depictions of leisure most represented the privileged bourgeois life.[17]

Yet, lurking in the new industrial and cultural order were serious problems. Economic power had been centralized in a few hands, leading to such diverse problems as inadequate worker incomes to governmental corruption from the federal down to the local levels. Despite the installation of water, sewage and electrical systems and the paving of streets, urban areas were not the idyllic mecca many bourgeoisie migrating from rural areas might have hoped they would be. During the period immigrant populations from southern and eastern Europe poured into the urban areas.

Figure 2



William Merritt Chase, *Ring Toss,* ca. 1896

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Urban populations grew; class divisions formed; and the city began to be viewed by many as impersonal at best and corrupt and filthy at worst. For the upper middle class, the new "mass society" supported their privileged social position but also damaged the traditional rural, egalitarian American sense of community.[18] A sense of community was replaced by the "feel ... of a small town gone out of control."[19]

Class, in a sense, became community in the new industrial order of mass society — much to the horror of those with established wealth and power preceding the great new fortunes of urban-industrial America. Privilege could be a precarious position. New wealth and values were replacing old. And crusaders, muckrakers and other social reformers were beginning to take action as early as the 1880s. Thus, it is likely the paintings and photographs of the late nineteenth-century leisure class not only celebrated the social positions and values of the privileged, but reaffirmed them as mass society began to take its toll. In this sense paintings and photographs of the late Victorian era likely served as forms of an emerging "therapeutic ethos" — an ethos stressing psychic health and self-realization in an increasingly fragmented and diffused world.[20]

Perhaps this helps explain why one sees so many women and children in the leisure-oriented paintings and photographs of the period. Because of the growth of industrialization and the accompanying wage-labor system in the nineteenth century, men and women divided into distinct spheres of work — work and economy became the male sphere; home and family the female sphere. In marxist terms, men became tied to productive labor while women became tied to reproductive labor. This split led to men and women having distinctly different personalities, according to late nineteenth-century cultural constructions of meaning. As participants in a competitive capitalist economy, men assumed characteristics such as being ruthless and self-seeking. However, women, as "guardians of the family" and "creators of the home," assumed characterisitcs such as self-sacrifice, generosity and sensitivity.[21]

Women were considered to be different from but in many respects equal or even superior to men. In bourgeois circles of the late Victorian era, women were certainly considered more virtuous — the caretakers of morals and manners. They were often considered the "conscious and the housekeepers of America," and their "virtue constituted a national resource."[22] The children of the upper classes were thought of in similar terms — they represented a "salvation born out of innocence" which could lead to a "new, moral America born out of the purity of its children."[23] Thus, the paintings and photographs of privileged women and children were likely more than displays of prosperity. The delicate woman appearing in a Thomas Dewing painting or a Clarence White photograph was more than a late Victorian houshold's "chief ornament," as Thorstein Veblen claimed.[24] She — and her children — also represented the bourgeois hope for a perfect civilization, guiltless and pure, within a mass society.

In closing, Clarence White's *Ring Toss* is a photograph with several layers of meaning. As a form of plagiarism perhaps approaching kitsch, it represents the aspirations of a group of amateur American photographers at the end of the nineteenth century. Pictorialists such as White tried to develop photography into a legitimate 'high art' form by imitating the codes and conventions of painting — from composition and exhibition of works to organization of groups. White's *Ring Toss,* as one of many late Victorian visual artifacts representing private, leisure-oriented, female bourgeois pursuits, also indicates particular perspectives concerning class and gender. Such representations — especially those of women and children — were displays of status, no doubt.

But they may have also offered a sense of hope to a society dominated by patriarchal and capitalist ideals through reaffirming particular bourgeois values and constructions of meaning in a period increasingly fragmented and diffused by the new urban-industrial order.

NOTES

[1] In his articles "Style as Evidence," *Winterthur Portfolio* 15:3 (Autumn 1980): 197-210; and "Mind in Matter: An Introduction to Material Culture Theory and Method," *Winterthur Portfolio* 17:1 (Spring 1982): 1-19, Jules David Prown advocates analyzing the styles — the particular forms — of cultural artifacts because "the way in which something is done, produced or expressed" in a society indicates "unstated" constructions of meaning such as "beliefs ... assumptions, attitudes and values." The style of an object is a nonverbal "cultural, stylistic fingerprint." This emphasis on style is a valuable analytical tool for one interested in historical cultural constructions of meaning, but it should not be the sole method of analysis, as Prown occasionally admits.

Thus, this paper includes an analysis of style but grounds it in historical and sociological analyses. In this sense the most problematic area of Prown's method is avoided —that of considering the object as a sort of timeless 'text' through which one can arrive at an "objective" yet "affective" reading similar to its original producer and users. Prown appears to confuse *biological perception* (all humans sense the same objects similarly no matter what the epistemological context) with perception as a *process of constructing meaning* that is always grounded in a particular space and time. In this sense I agree with Janet Wolff, who writes that "... the way in which we 'translate' or interpret particular works is always determined by our own perspective and our own position in ideology. ... In short, the reading of any cultural product is an act of interpretation." See Wolff, *The Social Production of Art* (New York: New York University Press, 1984) pp. 96-97.

[2] See Ulrich F. Keller, "The Myth of Art Photography: An Iconographic Analysis," *History of Photography* 9:1 (January-March 1985), pp. 3-5; and Ronald G. Pisano, *Idle Hours: Americans at Leisure, 1865-1914* (Boston: Little, Brown and Company, 1988), pp. 68-69.

[3] Mary Ellen Hayward, "The Influence of the Classical Oriental Tradition on American Painting," *Winterthur Portfolio* 14:2 (Summer 1979), pp. 109-110.

[4] Jules David Prown, *American Painting: From Its Beginnings to the Armory Show* (New York: Rizzoli International Publications, Inc., 1987), pp. 107-111.

[5] Richard Boyle, *American Impressionism* (Boston: New York Graphic Society, 1974), p. 148.

[6] See Abraham A. Davidson, *The Eccentrics and Other American Visionary Painters* (New York: Dutton, 1978), pp. 113-127; and Matthew Baigell, *Dictionary of American Art* (New York: Harper and Row, 1979), pp. 355-356.

[7] See Pisano, *Idle Hours*, pp. 32-33.

[8] See Van Deren Coke, *The Painter and the Photograph: From Delacroix to Warhol* (Albuquerque: University of New Mexico Press, 1972), pp. 78-94; and Boyle, *American Impressionism*, pp. 11-30.

[9] The following discussion of pictorialism is primarily based on Ian Jeffrey's *Photography: A Concise History* (New York: Oxford University Press, 1981), pp. 81-104; Beaumont Newhall's *The History of Photography from 1839 to the Present* (Boston: Little, Brown and Company, 1982), pp. 141-166; Roberty Doty's *Photo Secession: Photography as a Fine Art*

(New York: George Eastman House, 1960), pp. 9-27; Ulrich Keller's "The Myth of Art Photography: A Sociological Analysis," *History of Photography* 8:4 (October-December 1984), pp. 249-275; and Christian Peterson's "George Timmins' Early collections of Pictorial Photography," *History of Photography* 6:1 (January 1982), pp. 21-26.

[10] The terms 'bourgeoisie' and 'bourgeois' are often used differently by different scholars. In this paper, a marxist-oriented definition of a class antithetical to the proletariat is used rather than the traditional French definition meaning merely the middle class. Thus, the term 'bourgeois' is interchangeable with the phrase *upper* middle-class throughout this text.

[11] Much of the following backgrounding of White's life is based on Jerry Mason, ed., *The International Center of Photography Encyclopedia of Photography* (New York: Crown Publishers, Inc., 1984), pp. 556-558; Jeffrey Ians, *Photography*, pp. 94-96; and Bonnie Yochelson, "Clarence H. White Reconsidered: An Alternative to the Modernist Aesthetic of Straight Photography," *Studies in Visual Communication* 9:4 (Fall 1983), pp. 26-44.

[12] Boyle, *American Impressionism*, p. 133.

[13] White's role as an influential instructor of many successful American art, commercial and mass media photographers is an interesting topic, but beyond the scope of this paper. For an analysis of how White influenced commercial photography in the 1920s through the 1940s, see Bonnie Yochelson's "Clarence White Reconsidered" in *Studies in Visual Communication*.

[14] See Ronald Pisano's *Idle Hours*, pp. 66-80, for an interesting discussion of late nineteenth-century bourgeois children, games and painting.

[15] Michael and Edwin Emery, *The Press and America*, 6th ed., (Englewood Cliffs, New Jersey: Prentice Hall, 1988), pp. 184-188.

[16] Russell Lynes, *The Art Makers* (New York: Dover Publications, Inc., 1970), pp. 408-409, 423-431.

[17] Pisano, *Idle Hours: Americans at Leisure*, pp. 1-4, 49.

[18] Garth S. Jowett, "The Emergence of the Mass Society: The Standardization of American Culture, 1830-1920," *Prospects* 7 (1982), pp. 207-225.

[19] Caroll Smith-Rosenberg, *Disorderly Conduct: Visions of Gender in Victorian America* (New York: Oxford University Press, 1985), p. 170.

[20] For a discussion of "therapeutic ethos," see T. Jackson Lears, "From Salvation to Realization," in Fox and Lears, *The Culture of Consumption: Critical Essays in American History, 1880-1980* (New York: Pantheon, 1983), pp. 1-38.

[21] Julie A. Matthaei, *An Economic History of Women in America* (New York: Schocken Books, 1982), pp. 115-116.

[22] Caroll Smith-Rosenberg, *Disorderly Conduct*, p. 173.

[23] Anne Tropp Trensky, "The Saintly Child in Nineteenth-Century American Fiction," *Prospects* 1 (1975), pp. 412.

[24] Thorstein Veblen, *The Theory of the Leisure Class*. reprint (New York: The Modern Library, 1931), p. 179.

Decoding "Field of Dreams": Movies, Baseball, and the American Dream

by
Gretchen Bisplinghoff

Hollywood . . . The Dream Factory . . . "the stuff dreams are made of" . . .a FIELD OF DREAMS. Throughout the history of the movies, a recurring visual metaphor for Hollywood and its product has been dreams and dreaming. Film theoreticians have long noted similarities between the individual movie-going experience and the dream state. They have discussed the common elements between the two states that contribute to a heightened impact of film on the individual's psyche. Their discussion focuses on the manner in which film operates on an unconscious level by simulating the dream condition. In his analysis, Parker Tyler refers to "dream symbols," and "the frequently unconscious magic employed by Hollywood--a magic of dream creation that far transcends its literal messages."[1] These dream symbols also operate on the level of the collective. Societal dreams and nightmares are played out on the screen. American culture is reflected and refracted through film's prism of images and icons, which in turn reflects its influence.

Hollywood has often used the game of baseball as a continuing motif to depict a particular view of America, its dreams and values: ". . . baseball lends itself to symbolism and myth like no other sport. Using baseball to somehow define ourselves and/or our country is an undeniable lure. . . ."[2] There has been a recent upsurge in baseball films--with BULL DURHAM, EIGHT MEN OUT, MAJOR LEAGUE, THE BABE, MR. BASEBALL, and especially, the hit movie of 1989, FIELD OF DREAMS. FIELD is about dreams on both the individual and collective levels. This discussion of FIELD OF DREAMS will analyze the film's structuring of individual perceptual response to its visual messages, as well as its unique contribution to our cultural myths using baseball as visual metaphor. The central premises of the film revolve around seeing; reading the visual messages "correctly," according to the protagonist's point of view.

DREAMING

On an individual level, our response to the film experience can be compared to the experience of dreaming. Our relaxed state, surrounding conditions and responses suggest correlations. These correlations have been noted and studied for their significance. Jean-Louis Baudry points out that: "A parallel between dream and cinema had often been noticed: common sense perceived it right away. The cinematographic projection is reminiscent of dream, would appear to be a kind of dream, really a dream, a parallelism often noticed by the dreamer when, about to describe his dream, he is compelled to say "'It was like in a movie. . . .'"[3] He goes on to discuss his interpretation of the corresponding elements (particularly concerning the visual images) of dream and film. A summary of these features include: "1. The dream apparatus has the following features: inhibition of movement; lack of reality testing; an imagistic medium; a dark room; projection; a screen; a more-than-real impression of reality; a tendency to efface the distinction between perception and representation. 2. The cinematic apparatus has exactly the same features noted in premise 1."[4]

FIELD OF DREAMS is specifically about an individual's pursuit of his dreams. Through careful structuring of perception, his dream becomes the audience's. It's important to foreground this connection to see how this then becomes a part of the audience's collective experience of the dream and the vision of the American Dream that it imparts. The film structures perception and reception of this vision through literalizing the idea that "seeing is believing." Early in the film, Ray Kinsella (Kevin Costner) comes down in the morning to find his daughter Karen watching the film HARVEY on television as she eats her breakfast. Jimmy Stewart's character is describing how he met his friend Harvey, an invisible six foot rabbit. Kinsella turns the television off. When she protests that the film is funny, he replies: "No, it's not. The man is sick, very sick." This harsh response to the earlier film's central fantasy immediately establishes the fact that Kinsella is not the type of person to see things that aren't there; that would be crazy, and he's a practical man with normal perceptions of reality.

The film thus sets up his character and outlook as trustworthy--this credibility is important because the opening segment shows him rejecting his family and going to college at Berkeley during the height of the sixties. The segment uses a series of stills with Ray's voice-over to encapsulate his life: growing up as an only child first with his parents, then with his father as a single parent, then meeting and marrying Annie who convinced him to buy a farm. In the last line of the voice-over, he says: "Until I heard the voice, I'd never done a crazy thing in my whole life." He's a child of the counter culture who has become an Iowa farmer, but his responses should clearly be perceived as normal by the audience before the dream quest begins. His response to HARVEY also characterizes his quest as serious, not a frivolous flight of fancy. Throughout the rest of the film, he talks about being crazy, but this is thus never a serious issue for the audience.

"REALITY"

In addition, this early scene points out another difference in the positioning of the audience. In HARVEY, only Elwood Dowd can see the rabbit. He is invisible to the other characters and to the audience. The audience therefore chooses whether to share the protagonist's vision. However, the audience shares Ray Kinsella's perceptions from the start. First, only Ray and the audience hear the voice that tells him: "If you build it, he will come." More importantly, when he decides what these words mean and looks out into the cornfield, both he and the audience see a ballpark as a shared interpretation of the message. And, so there is no mistake, this vision appears twice. Twice the audience sees Ray looking, and twice the lights literally come on as the ballpark appears. Then Shoeless Joe appears, in uniform, in medium close up, looking over his shoulder at the camera.

Ray builds the baseball diamond; the film documents the transformation from cornfield to baseball field. The baseball park becomes a concrete reality for all the characters, especially his shocked neighbors, and the audience. However, when Shoeless Joe Jackson and other members of the scandal-plagued 1919 White Sox team start coming out of a cornfield "land beyond" death and playing on the field, only certain people can see them. Only Ray, and those who believe in his vision, can see the players, and that includes the audience. These players are clearly visible to the audience from the beginning; they aren't ghostly or transparent in appearance (except when they re-enter the "other" world). They are a reality for the audience, played by flesh and blood actors. When Karen meets Joe she asks if he's a ghost and he asks what she thinks. She says: "You look real to me." He replies: "Then I guess I'm real."

"SEEING IS BELIEVING"

The rest of the film builds upon this distinction between those who can see and thus believe ("seeing is believing") and those who can't. Those who need further evidence of the truth of Ray's quest, like Terence Mann and Ray's brother-in-law Mark, are literally convinced by visions. Once they see these visions, each more miraculous than the last, they join Ray. Terence Mann resists all of Kinsella's arguments until he also sees a message that flashes on an electronic scoreboard. However, when he doesn't acknowledge right away that he saw the message about the ballplayer "Moonlight" Graham ("You didn't see that?"), Ray gives up on him because he's "lost his passion." When he does acknowledge the message, Ray repeats "You saw it" three times, and indicates that they (--and the audience of course) were the only ones who saw it. Mann then joins Kinsella on the trip to get Graham, confirms his belief when he sees Shoeless Joe, and finally becomes the spokesman for the meaning of Kinsella's vision. Mark is the central figure of resistance throughout the film. He can't see the players. He and his partners hold title to the farm and threaten to foreclose if Ray doesn't sell. At the end of the film, Mark attacks Ray and Karen is injured in the scuffle. Mark is converted to Ray's way of seeing when "Moonlight" Graham steps off the field where he was an invisible (to Mark) rookie player to become Doc Graham (who has been dead for twenty years), and saves Karen's life. Mark watches, stunned, and then asks: "When did these ballplayers get here?" Then he immediately says: "DO NOT sell the farm, Ray. Don't sell the farm."

Because the audience has identified with Ray's mission from the beginning through structuring of their perceptions, they label characters according to whether they also see the players. Characters who don't see as Ray and the audience do are perceived as negative. They aren't perceived as having another, equally legitimate point of view; they are wrong. Until he is "converted," Terence Mann is antisocial, misanthropic and, at one point, literally threatens Ray's life. Mark is trying to help his sister's family in the way that makes sense under normal circumstances. But, because he literally can't see the importance of the farm on

Ray's "higher" level, he is in constant conflict with the family and assumes the role of the villain in the eyes of the audience. This is reinforced at the end of the film when Mark apparently causes an accident which nearly kills Karen. His denial nearly has fatal consequences. In the context of the film's structure, only Ray's (and the audience's) steadfast belief in his vision has brought a ghost doctor back from the dead to save his daughter's life at that moment.

However, it is in fact Ray's fault that his daughter was on those bleachers and almost killed. His vision put her there and caused the conflict, and his physical reaction to Mark causes Mark to let go of her. However, in this climactic vision, the audience and Ray are vindicated in their belief in a tangible "real" (off the field) way for the first time. And, like the progression in leaps of faith, the payoffs for the believers now fall into place in levels of increasing magnitude. Terence Mann is invited to join the ballplayers on the other side. As a writer and former baseball fanatic, this is the fulfillment of his dreams. Ray finally realizes the dream that the field represents on a personal level for him; the return of his dead father in the youthful prime of his baseball career before Ray was born, and the reconciliation of the estranged father and son. As the two play catch, the camera pulls back in an overhead shot to reveal the headlights of a society drawn to this field ("they don't know why") to fulfill their collective dreams (for which they'll pay $20 each).

IMPLICATIONS

The process of identification and seeing and sharing correctly has been built in gradually widening influence through the film, from one individual sharing his vision with other individuals both onscreen and within the audience, to its broader effect on the society onscreen and off. At the end of the film, one man's dream is everyone's dream. However, one man's dream has also become everyone's reality. But what are the implications of this dream? What images are being accepted as the American Dream? Mann says that America has been "erased," but baseball remains the one constant; it's part of our innocent past as children and as a nation. It "reminds us of all that once was good and will be again" in this country. It's important to note that the meaning of "good" is not explicitly defined verbally, it is demonstrated visually, just as the ultimate meaning of Ray's vision is explained through images, not in dialogue.

The audience watches dreams come true on the field--those of the players, of Mann, Graham and Kinsella. They see their dreams represented by a young, innocent, all-male, all-white baseball world; a world untouched by scandal, assassination, integration, the Civil Rights Movement and the Women's Movement. This world represents "all that once was good and will be again"--before the struggle and growth of the years after 1919, especially during and after the sixties. The audience sees only white males playing the game; only males have their dreams fulfilled. Literally only men can go on the field to play or into the cornfield beyond; females, however supportive, cheer from the sidelines. And this is clearly part of the vision: "Asked if there is a Heaven, the spirit of Ray's father replies, 'It's the place dreams come true.' Ray looks at the farmhouse and his wife and child, and says, 'Maybe this is Heaven.'"[5] (Note: This is a long shot of the gleaming white farmhouse on a hill at sunset, with Ray's wife and daughter sitting on the front porch swing as he fulfills his dreams on the field.) Thus, though the film is structured to represent society's dreams, a return to its vision would, in fact, exclude a large portion of the population.

A GAME OF CATCH

Male bonding, particularly between father and son, takes place through the game: "Shoeless Joe and Ray feel each other out, not with words but with fungoes and BP."[6] Fathers and sons reconcile with a game of catch. Ray rebelled against his father by refusing to become a baseball player. He refused to play ball with his father literally and metaphorically: a rebellion against father and society. He says to Mann: "Can you believe that? An American boy refusing to have a catch with his father?" Ray's father died before Ray was able to apologize or tell him that he loved him. His quest is resolved by the film in their nonverbal game of catch. However, this too represents reinforcement of traditional values and gender roles, of men who don't express themselves openly through words, but use a handshake and a game of catch to say "I love you." The game of catch as visual symbol of father-son bonding appears throughout mass media images of television and film. (Recent examples include DAD and THE NATURAL.)

However, FIELD makes a shift in the meaning of this visual symbol. FIELD OF DREAMS assigns values to the roles of fathers and sons within this visual icon. This reconciliation takes place between unequals: a young, innocent father and his penitent son. The "good son" plays catch with his father. Good sons and good fathers are now instantly identifiable solely on the basis of their participation in the symbolic game and use of its icons. In HOOK, the now grown up Peter Pan spends too much time on his work and not enough time with his children. But the scene that identifies him as a bad father occurs when he misses his son's Little League game (and his son strikes out). He arrives to an empty field; his son can't forgive him. Hook becomes a good father to the boy when he gives him a second chance, a dream come true--a baseball game with Hook in attendance and the winning home run. Hook catches the winning gameball literally in front of the disguised Peter's face and presents it to his "new" son. The baseball operates as a visual icon of their bonding and the correct path to reach it.

Popular culture icons are "visual representations of our myths" which possess "the power to provide a sense of meaningful order and to integrate the personality of the viewer into that order."[7] FIELD OF DREAMS carefully structures the dream experience of the film on all levels to integrate the audience into its order, its myth. As it accomplishes this through visual symbols, it is critical to understand the operation of these icons in order to understand how such a film shapes our culture.

ENDNOTES

[1] Parker Tyler, "Magic and Myth of the Movies," in *Film Theory and Criticism*, Gerald Mast, Marshall Cohen and Leo Braudy, ed. (New York: Oxford University Press, 1992), 729.

[2] K. M. Chanko, "Field of Dreams," *Films in Review*, 40 (August/September, 1989), 421.

[3] Jean-Louis Baudry, "The Apparatus: Metapsychological Approaches to the Impression of Reality in the Cinema," in *Film Theory and Criticism*, Gerald Mast, Marshall Cohen and Leo Braudy, ed. (New York: Oxford University Press, 1992), 698.

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